

South Carolina Aquatic Invasive Species Management Plan



Prepared in coordination with the
South Carolina Aquatic Invasive Species Task Force
by the
South Carolina Department of Natural Resources

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Acknowledgements

Executive Summary

Introduction

It is well documented and acknowledged that non-native aquatic invasive species cause serious ecological and economic harm to water resources in many regions of the country. Congress first addressed this concern by passing the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, which targeted the control of zebra mussels in the Great Lakes. Later it passed the National Invasive Species Act of 1996 (P.L. 104-332), which greatly expanded nationwide recognition and coordination of aquatic invasive species. This law established the Aquatic Nuisance Species Task Force and made it responsible for developing voluntary national guidelines for ballast water management. It also charged the ANS Task Force with national coordination of aquatic invasive species through regional panels. Section 1204 of the Act specifically authorized the development of comprehensive state invasive species management plans and authorized federal matching funds for states with comprehensive management plans that were submitted to and approved by the ANS Task Force.

Purpose and Scope

Clearly, one of the purposes for completing a state aquatic invasive species management plan is to help satisfy a requirement of the National Invasive Species Act. The approved plan may even result in the state receiving federal assistance for managing aquatic invasive species. However, the greater value in completing the plan and the primary purpose of the South Carolina Aquatic Invasive Species Management Plan is to provide guidelines for the coordinated management of aquatic invasive species in order to minimize their ecological and economic impacts to the state's marine and freshwater environments. The Plan identifies current and potential aquatic invasive species problems and threats to the state and recommends specific actions that could prevent additional aquatic invasive species introductions and allow for rapid and effective response to problems when they arise. Secondly, the planning process establishes a formal communication network of public and private entities through the creation of the State AIS Task Force. The Task Force is a critical element in ensuring good communication and diverse input to management decisions.

The scope of the plan is limited to the State of South Carolina; however, it is understood and expected that management activities will need to extend beyond these political boundaries. Three out of the state's four major river basins receive inflow from neighboring states. Consequently, state authorities need to work closely with their counterparts in Georgia and North Carolina to minimize possible AIS introductions from those states.

Plan Development Process

A multi-agency task force was assembled to provide guidance in developing the plan. Individual task force members were selected based primarily on their experience with invasive species issues. Most members were selected from the State Aquatic Plant Management Council, the State Aquatic Nuisance Species Communication Plan Advisory Committee, and the State Zebra Mussel Task Force. The Aquatic Invasive Species Task Force included 34 members representing ten state agencies, eight federal agencies, four private entities, and 4 non-profit organizations. A complete list of AIS Task Force members is presented in Appendix A.

The plan was developed over a one-year period starting in July 2006. The AIS Task Force met every other month to review homework assignments and work on specific sections of the plan. A schedule was provided to all members that included proposed meeting dates for the year and anticipated completion dates for sections of the plan. A web site that included detailed information about the planning process and task force activities was established to help facilitate communication among task force members and provide the public with up-to-date information on the plan's development. Communication among task force members between meetings was conducted primarily by email. The final draft was sent out for public review and comment for a 30-day period. Comments were reviewed, discussed among Task Force members, and incorporated as appropriate. The final report was forwarded to the Governor's Office and sent to the Aquatic Nuisance Species Task Force for approval.

Interaction with Other Plans

Development of the Aquatic Invasive Species Management Plan was closely coordinated with recommendations in the 2005 State Comprehensive Wildlife Conservation Strategy (SCWCS). In addition to numerous species-specific recommendations, The SCWCS identifies five general conservation actions pertaining to invasive species. These are:

1. Prevent the spread of existing invasive and non-native species, eliminating them, where possible.
2. Determine the impacts of invasive and non-native species on South Carolina's priority species and habitats used by those species.
3. Strive to prevent the import of additional invasive and non-native species to South Carolina.
4. Develop and conduct an education and outreach campaign to raise awareness of the impacts of introducing non-native species into South Carolina.
5. Develop partnerships with other entities in South Carolina to address impacts associated with invasive and non-native species.

The Aquatic Invasive Species Management Plan addresses each of these action items.

Since 1981, the Department of Natural Resources in conjunction with the State Aquatic Plant Management Council has developed annual Aquatic Plant Management Plans that identify public waters with nuisance aquatic plant problems and prescribe management actions. This planning process is established by law. The AIS Management Plan recognizes this as an effective statewide management effort for the control of invasive aquatic vegetation. It is identified as an action item in the AIS Management Plan that should continue as currently established.

Define “aquatic invasive species”

Many non-indigenous species can coexist with native species and may be beneficial. These species typically do not reproduce rapidly or develop large populations. For the purposes of this plan the term “aquatic invasive species” refers to nonindigenous species

that live most or all of their lives in freshwater or marine/estuarine environments and have the potential to adversely affect ecological health or economic activity.

Problem Description

Background

Our increasingly global economy has encouraged the rapid movement of plants and animals to areas outside their native ranges. Not all non-native species cause problems; however, those that are able to avoid predation and disease and are able to reproduce rapidly or at least persistently can become very abundant. It is these invasive non-native species that are cause for concern. Aquatic invasive species adversely impact native plant and animal populations, disrupt natural ecosystem functions, and impair beneficial use of our waterways. Specific impacts include:

- Blocked water flow and clogged water withdrawals for municipal, industrial, agricultural purposes and for electric power generation
- Impaired recreational uses (swimming, hunting, fishing, boating)
- Fouled boat hulls and motors
- Reduced waterfront property values
- Degraded water quality
- Declines in fin and shellfish populations
- Reduced diversity of native organisms and desirable wildlife populations
- Flooding due to restricted flow, and
- Expanded breeding habitat for mosquitoes and other pests.

South Carolina has an abundance of freshwater and marine resources. Four major river basins, the Savannah, ACE (Ashley, Combahee, and Edisto), Santee, and Pee Dee include over 11,000 miles of rivers and streams with an average daily flow of about 30 billion gallons. These basins also contain about 1,600 impoundments of ten acres or more in size with a total surface area of over 521,737 acres. In addition, the state's 200 miles of shoreline along the Atlantic Ocean incorporates about 750,000 acres of estuaries. These waters provide important habitat for fish and wildlife populations, support diverse

recreational activities, provide a source of water for industrial, municipal, and agricultural withdrawals, and support commercial and recreational navigation that are important to the economy of the state. The influx of non-native invasive species can severely impact these important water resources.

It is estimated that non-native invasive species cost the U.S. economy \$120 billion annually in lost production, control costs, and environmental damage (Pimentel et al., 2005). In addition, about 42 percent of the nation's endangered or threatened species are significantly impacted by non-native invasive species. While the full economic impact from aquatic invasive species is not well documented for South Carolina, a critical incident in 1991 and state records of aquatic plant control costs since 1980 help frame the extent of the problem.

The aquatic weed hydrilla is attributed to causing one of the greatest single impacts from an invasive species in the state. Hydrilla populations in the Santee Cooper Lake System, a large hydroelectric project north of Charleston, had been expanding rapidly since 1982. Following a storm in 1991, large rafts of hydrilla were dislodged and floated into the water intake canal and impinged on the debris screens of the St. Stephen Hydroelectric Facility. The power plant was shut down for weeks while hydrilla was removed from the screens. The economic impact from that incident alone was estimated at \$4 million in lost electric power generation and associated costs. In addition, the shutdown prevented water flow downstream, which resulted in oxygen depletion and one of the state's largest fish kill incidents with \$526,000 in lost game fish. Hydrilla continued to impair electric power generation at St. Stephens to a lesser extent during subsequent years.

The economic impact of invasive species infestations to the state is also reflected by the cost of preventing water-related problems through ongoing control operations. From 1981 to 2006 a total of \$22.6 million has been spent to control hydrilla and other priority invasive plant species in public waterways. These expenditures are a combination of state, federal, and local (public and private) funds. This cost does not include aquatic plant control expenditures by the private sector and federal facilities around the state. It

is also limited to the control of invasive aquatic plants and does not include impacts from the Asiatic clam, which invaded the state in the 1970s, certain non-native game fishes stocked over the past 40 years, and a variety of marine organisms released along our coast.

Ecological Impacts

Aquatic invasive species can cause unexpected ecological consequences. It has been well known that invasive aquatic plants, such as hydrilla and phragmites, can develop large dense populations that displace desirable native vegetation. But other far-reaching indirect impacts may also result. One example of the complexity some ecological impacts is illustrated by the relationship of some invasive aquatic plant species and the deadly brain lesion disease, avian vacuolar myelinopathy (AVM), in coots and bald eagles.

First reported in 1994, AVM has been the cause of death for at least 100 bald eagles (*Haliaeetus leucocephalus*) and thousands of American coots (*Fulica americana*) at 11 sites from Texas to North Carolina (Thomas et al. 1998). Many of these deaths occurred around J. Strom Thurmond Reservoir in South Carolina. Even at these high death rates, it is suspected that the actual number of eagle deaths from AVM is much higher; only 12% of banded carcasses are recovered. Additionally, bald eagles are long lived with low fecundity, so any increase in adult mortality rates could rapidly affect the recovery of this threatened species. Countless waterfowl have also died from the disease including coots (primarily), Canada geese (*Branta canadensis*), mallards (*Anas platyrhynchos*), ring-necked ducks (*Aythya collaris*), and buffleheads (*Bucephala albeola*).

While the ultimate agent for AVM has yet to be identified, experimental and field surveys point to a naturally produced neurotoxin that is transmitted from aquatic vegetation to waterfowl and then to bald eagles as illustrated in Figure _____. Laboratory experiments (Fischer et al. 2003; Birrenkott et al. 2004; Lewis-Weis et al. 2004) have

confirmed that this food chain is the transfer mechanism for AVM in both waterfowl and eagles.

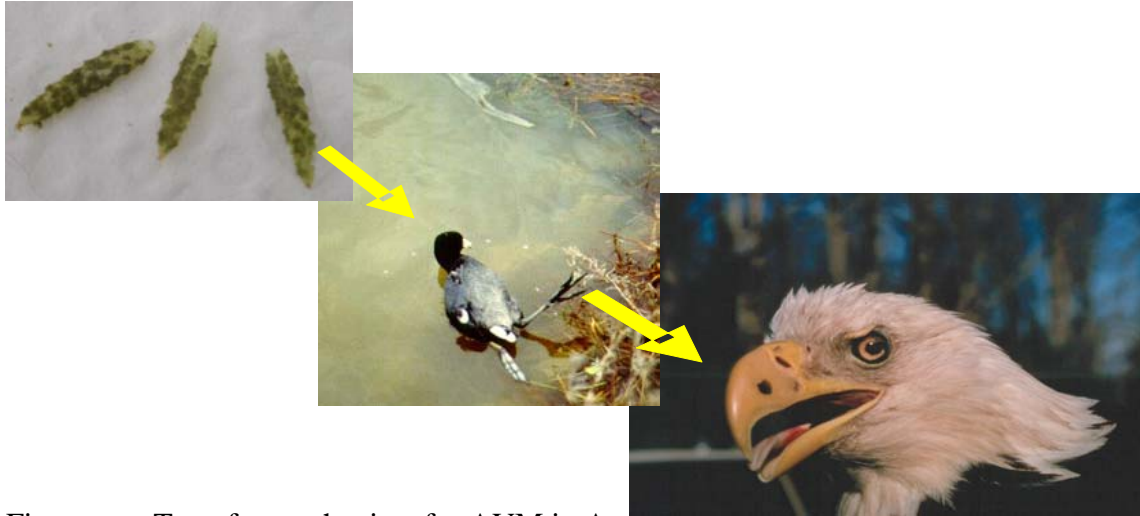


Figure __. Transfer mechanism for AVM in American bald eagles.

The disease agent appears to be an uncharacterized neurotoxin produced by a novel cyanobacterial epiphyte in the order Stigonematales (Komarek et al. 2003; Wilde et al. 2005). It covers up to 95% of the surface area of hydrilla leaves in reservoirs where AVM deaths have occurred. The suspect Stigonematales species is found on hydrilla, Brazilian elodea (*Egeria densa*), and Eurasian watermilfoil (*Myriophyllum spicatum*) and several native aquatic plants at AVM sites. Since the invasive plants are capable of producing much greater overall biomass and substrate for colonization, they are more of a concern than native vegetation. Not only is there more biomass of the aggressive invasive plant species, but this algal species grows to a much higher density on hydrilla (50-95% surface area coverage) relative to the native plants (5-10 %) it colonizes. Only systems with invasive aquatic plants, primarily hydrilla and Brazilian elodea, have had the AVM disease expressed with high bird mortality (eagles and waterfowl).

Species Introductions

The U.S. Geological Survey Center for Aquatic Resources Studies maintains an excellent database on introduced aquatic nonindigenous species by state. The database is updated on a regular basis. At the time of this report several marine invertebrate species for South Carolina had not been added. The most recent data on nonindigenous aquatic species for South Carolina and other states can be accessed at the USGS web site located at <http://nas.er.usgs.gov>.

A review of the data for aquatic animals indicates that the number of non-native species introduced to the state has increased substantially in recent years (Fig. 1). About 87% of all non-native aquatic animal species introduced to the state were introduced after 1950. Most of these were fish (68%) and about 59% came from other regions of North America, eight percent from South America, and eight percent came from Asia (Fig. 2). By far most introduced aquatic animals are freshwater species (82%), followed by marine (15%) and brackish water (3%) species (Fig 3).

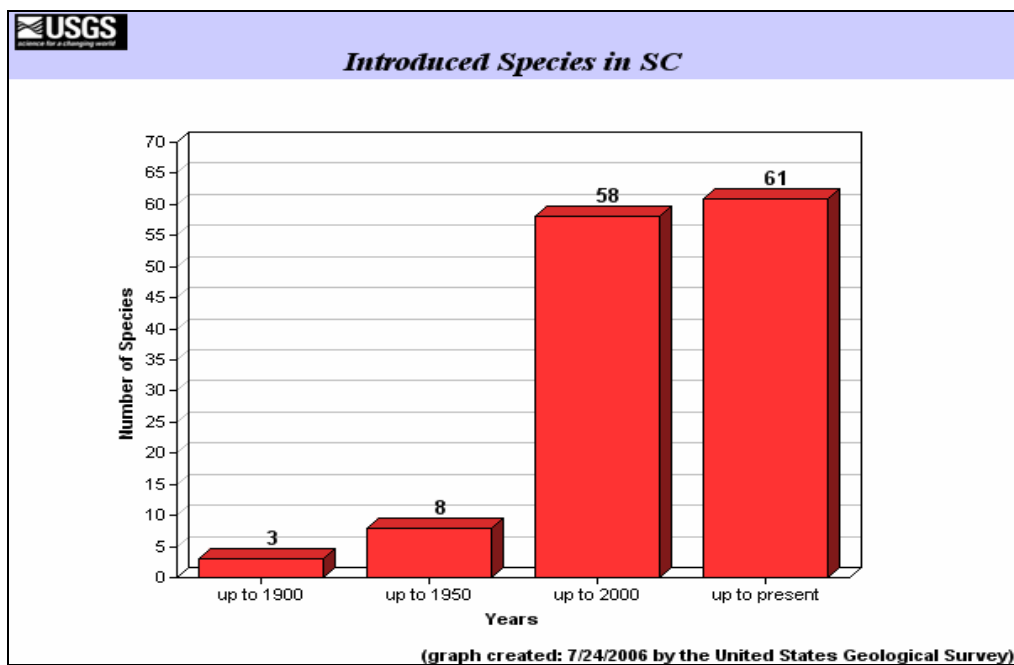


Figure 1 (Add asterix to indicate that several introduced invertebrates have not been added yet to the USGA database.)

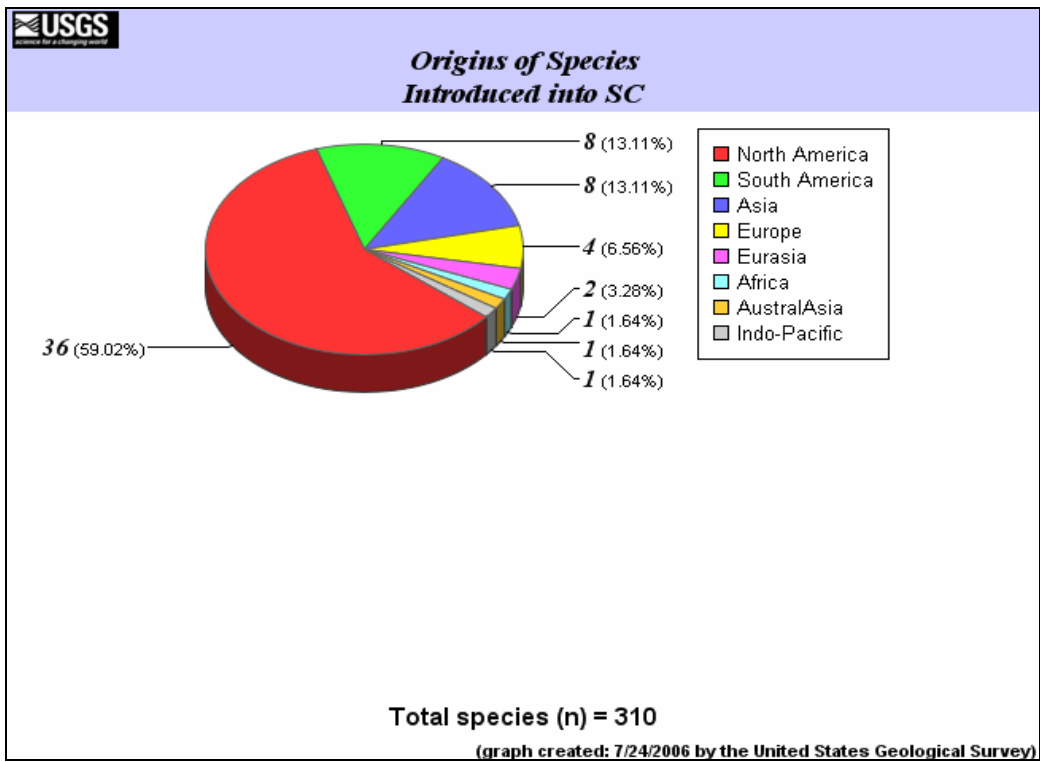


Figure 2

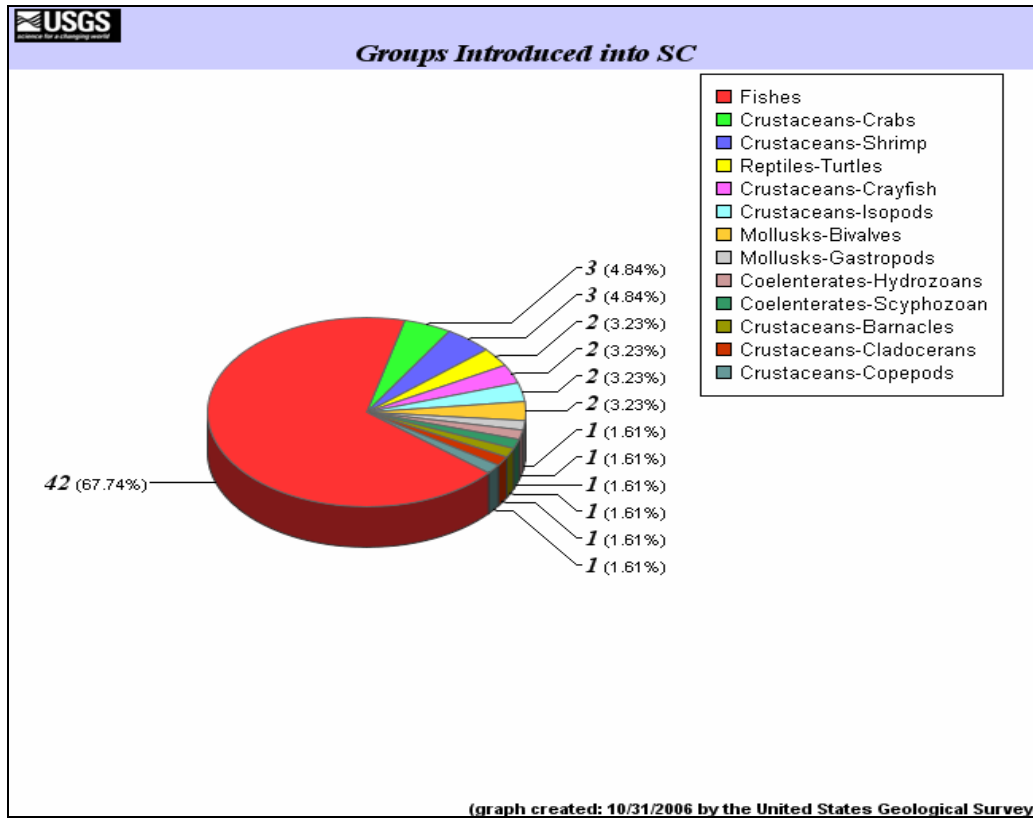


Figure 3

Unfortunately, the USGS database does not include non-native aquatic plants in the state summaries. If it did, the total number of introduced species would be even higher. However, the overall conclusion would be the same. That is, the state is experiencing an increasing influx of non-native species from locations all over the world. Aquatic invasive species of particular concern to South Carolina are discussed below.

Invasive Species of Concern

This section describes species that are particularly problematic to South Carolina. State management and control efforts are focused primarily on these specific species. However, there are other species of concern, and South Carolina will focus on preventing the spread of all aquatic invasives and controlling their impacts.

Freshwater Plants

Hydrilla (*Hydrilla verticillata*)

Hydrilla is an introduced submersed perennial originally from Asia. The two biotypes, dioecious and monoecious, that occur in the United States also occur in South Carolina. Dioecious hydrilla was first found in 1982 near a fishing camp in Lake Marion. It has spread to 11 public waterbodies and over 55,000 acres throughout the state. The largest populations have occurred in Lake Marion, Lake Moultrie, Lake Murray, the Cooper River, Goose Creek Reservoir, and Back River Reservoir. Lesser amounts occur in Lake Greenwood, Lake Keowee, and Lake Wateree. Monoecious hydrilla, which was first found in 1995 in the J. Strom Thurmond Reservoir on the South Carolina/Georgia border and more recently in North Carolina reservoirs near Charlotte, threatens to spread to additional South Carolina waters. Both forms were probably introduced inadvertently by boaters or anglers from fragments on recreational boats, their motors and trailers, and in live wells.

Hydrilla reproduces rapidly from plant fragments, tubers and turions, and forms very large populations up to 25 feet in depth. The greatest amount of growth occurs near the water surface where dense surface mats decrease plant diversity by displacing beneficial native species. Hydrilla increases mosquito breeding sites, impairs boating activities (sailing, motor boats and jet skies), clogs municipal and industrial water intakes, as well as cooling water intakes for electric power plants. It decreases oxygen levels and lowers water quality, and decreases lakefront property value. Hydrilla is the most problematic aquatic plant in the state with over \$14.7 million spent since 1982 in controlling over 58,000 acres statewide.





Hydrilla infested 90% of Goose Creek Reservoir in early 1990's.



Hydrilla covered over 10,000 acres in upper Lake Marion.

Water hyacinth (*Eichhornia crassipes*)

Water hyacinth is a showy, free-floating plant from Brazil that reaches up to 3 feet in height. Water hyacinth was most likely introduced to public waters by homeowners discarding water garden plants. Water hyacinths have been in the state prior to 1980 with

the largest concentration in water bodies near Charleston such as Back River Reservoir, Cooper River and Goose Creek Reservoir. Water hyacinths have spread south to the Ashepoo River and Savannah River, north to the Waccamaw River and Pee Dee River, and northwest to upper Lake Marion. Infestations have been found in small private ponds in Lexington County near Columbia. By forming new plantlets, a population can completely dominate and obstruct a body of water in a short period of time. Native species are excluded, and large populations may affect water quality. Its floating mats block public access and use of lakes at boat ramps; it also covers coves and shoreline areas, clogs industrial, municipal and electric power plant water intakes. Large infestations inhibit water flow causing upstream flooding during heavy rain events. Water hyacinth is the second most problematic invasive aquatic plant in South Carolina. Since 1985, over 14,000 acres of water hyacinth have been treated in South Carolina's public waterways at a cost of over \$1.3 million. Annual treatments help keep this prolific plant in check in most areas.





Water hyacinth in Indian Lake near the Waccamaw River, Georgetown Co.

Common reed (*Phragmites australis*)

Phragmites is a tall grass that grows up to 10 feet tall and forms dense monotypic stands. While it is native to North America, the variety that occurs in South Carolina originated in Europe. *Phragmites* was first noticed in the 1970s in waters near Georgetown where it is speculated that it arrived on contaminated dredge equipment from northern states. It is still most problematic in this area. The coverage of this plant is not fully known in South Carolina, but estimates are that it exceeds 3,000 acres and it is spreading. *Phragmites* is not a problem in major reservoirs. It is more commonly found in freshwater impoundments along the coast and in estuaries and marsh ecosystems. It is not good waterfowl food and it outcompetes native plants that provide food and habitat for waterfowl. Over \$1 million has been spent to control *Phragmites* in the state since 1985.



Phragmites colonies infesting waterfowl impoundment near the Intracoastal Waterway in Charleston Co.



Water lettuce (*Pistia stratiodes*)

Water lettuce is a free-floating, stoloniferous perennial from the tropical/subtropical regions of the world. Water lettuce was first found in South Carolina on the Waccamaw

River near Brookgreen Garden in 1991; however, cold winter temperatures apparently eliminated that population. It currently is present in Goose Creek Reservoir north of Charleston. This infestation came from a private upstream subdivision lake. Water lettuce forms large floating mats that impair water flow, public access and use of waterways, and clog water intakes. Large populations can completely cover the water surface in small lakes and small coves of large lakes and degrade water quality and impact native plants and animals. This species reproduces rapidly from a single plant and is easily spread to other water bodies by man.



Giant salvinia (*Salvinia molesta*)

Giant salvinia is a small, free floating, introduced aquatic fern. Giant salvinia was first found in South Carolina in 1995 in a private pond in Colleton County. The introduction originated from contaminated shipment of water garden plants from California. Close coordination and rapid response between SCDNR, Clemson Extension Service, and USDA resulted in successful eradication in 1995. A new population was found in 2004 in a Jasper County plantation pond. The introduction originated from contaminated water



garden plants purchased in Georgia. This population was successfully eradicated by 2006 using repeated herbicide treatments. Populations of giant salvinia in North Carolina and Georgia provide a close source for new infestations in South

Carolina. Giant salvinia can be a very problematic plant in South Carolina. Its rapid growth characteristics (can double its biomass every seven days) could make this one of the most problematic plants ever. Giant salvinia can impact irrigation systems, navigable waters, fisheries, electric power production, and municipal and industrial water intakes. Giant mats reduce light penetration and result in oxygen depletion. As light becomes limiting, it affects the growth and survival of phytoplankton and vascular plants. Oxygen depletion may be so severely reduced beneath a mat that it influences fish survival. Extensive mats may exacerbate a situation because they prevent water circulation and mixing.



Giant Salvinia covering a plantation pond in Jasper Co.

Alligatorweed (*Alternanthera philoxeroides*)

Alligatorweed is an aggressive emergent perennial from South America. The original

pathway of introduction to South Carolina is unknown, but likely originated from aquarium disposals. Alligatorweed is found throughout South Carolina but is most problematic in waters in the northern Pee Dee Basin. Alligatorweed spreads rapidly by fragmentation. Biological control agents introduced many years ago, such as alligatorweed fleabeetles and stem borer moths, keep populations in most of the state under control. Alligatorweed displaces native vegetation, disrupts navigation, recreation, and water flow by the formation of impenetrable mats. It decreases uptake for agricultural, municipal and industrial purposes and expands human health risks with increases in mosquito breeding habitats.



Alligatorweed on Black Mingo Swamp in Georgetown Co.



Brazilian elodea (*Elodea densa*)

Brazilian elodea was the most problematic submersed aquatic plant in South Carolina prior to the introduction of hydrilla in 1982. Original pathway of introduction is unknown. The earliest report of Brazilian elodea in the United States was from Millneck, Long Island where the plant was collected in 1893. It was offered for sale in the United States in 1915, where it was recommended as a good "oxygenator" plant. In South Carolina, populations have been identified in the Saluda River below Lake Murray, Savannah River near Augusta, Richard B. Russell Lake, Waccamaw River and small ponds upstate. After Brazilian elodea has been introduced into a lake it grows rapidly and creates dense mats on the waters surface. These mats will choke out native plants that don't grow as quickly. It impedes boating, fishing, swimming, water skiing and other aquatic activities. The mats are unsightly and provide poor habitat for fish. It will form a monotypic stand that can become so dense that water movement is restricted and can cause fluctuations in water quality, and it traps sediment. The fragmented pieces can clog water intake pipes. Because this plant spreads readily through fragmentation, mechanical controls such as cutting, harvesting, and rotoation (underwater rototilling) should be used only when the extent of the infestation is such that all available niches have been filled. Application of herbicide is recommended over mechanical control.



Water primrose (*Ludwigia hexapetala*)

The original introductory pathway of water primrose is unknown. Water primrose is found throughout the state in man-made impoundments but is most problematic from the fall line to the coast. There are problem populations in Back River Reservoir, Goose Creek Reservoir, the Santee Cooper lakes. Water primrose is an emergent perennial that grows to 3 feet tall but stems may be many feet long when floating on the water. This shoreline plant is very difficult to control due to extensive underground rhizomes.

Unlike most shoreline species new shoots can float on the water surface and extend far from shore. Adverse impacts include restricted public access to waterways and use of shoreline areas, impaired navigation in small channels, restricted water flow, formation of free-floating mats, and clogging of water intakes.



Water primrose covers shallow coves in Lake Murray.

Freshwater Animals

Mammals

Nutria (*Myocastor coypus*)



Photo:USGS

South Carolina's State wildlife officials are concerned that nutria may soon be showing up in the Savannah and Pee Dee river basins. Nutria were introduced from Argentina to the United States in 1938 as a biological agent for controlling aquatic weeds. During the 1950s initial destruction caused by these animals on marshes, rice and sugarcane field was documented, but their valuable fur had already become a target for fur traders. Harvesting of nutria fur caused them to be listed as protected wildlife in 1965. During the 1980s the international fur market declined and nutria populations started dramatically increasing and the damage to wetland habitats became intense. Ecological impacts from nutria are caused by herbivory damage in emergent marsh grasses where nutria graze. Concerted efforts to regenerate bald cypress forests have largely been unsuccessful due to nutria damage. Burrowing causes significant damage in areas of infestation. Large underground tunnels built by nutria weaken the sides of drainage canals, water impoundments and levees. Nutria overgrazing exacerbates cave-ins and erosion problems in these areas. Economic impacts from nutria have been seen in other states, but not in South Carolina at this time.

Reptiles

Red-eared slider (*Trachemys scripta elegans*)

Red-eared sliders are native to the Mississippi Valley and have been introduced to ponds, rivers and lakes throughout the southeast, including South Carolina. This is a subspecies of our native yellowbelly turtle (*Trachemys scripta*), which is found throughout most of the state, being absent from the Blue Ridge. Red-eared sliders were sold in South Carolina pet stores for many years and continue to be sold through other venues, such as flea markets and exotic animal trade shows. The pathway for introduction is release by pet owners into the wild. This species has become established, primarily, near cities in the coastal plain, such as Charleston and Beaufort. The primary threat associated with this non-native species is reduction in the genetic integrity of yellowbelly turtles. Red-eared sliders interbreed with the native species, which shifts the genetics of local populations of yellowbelly turtles.



Fishes

Spotted bass (*Micropterus punctulatus*)



Spotted bass populations are found in the Tennessee drainage and were probably illegally introduced to South Carolina by anglers. They are quite prolific where established and may be competitively displacing largemouth populations in upstate Piedmont and mountain lakes, as they are in Lake Lanier in Georgia. Spotted bass seem to dominate the fishery in largemouth bass lakes. Bass anglers are catching them in good numbers because of their relatively large population size. They seemed to be easier to catch, but the populations are so great that average size is going down compared to largemouth bass. Spotted bass are hybridizing with red-eye bass (*Micropterus coosae*), which is a native Piedmont mountain bass. The red-eye bass does not attain a large size like largemouth bass or support a large fishery, but hybridization may be eliminating this native bass species.

Flathead (*Pylodictis olivaris*) and blue catfish (*Ictalurus furcatus*)



Flathead catfish and blue catfish are native to the Mississippi drainage and were introduced into lake systems in South Carolina during the 1960s. These top predators thrived and became popular in lakes, especially in the Santee Cooper system. Flathead and blue catfish now support a large recreational and commercial fishery. They are now found in the Edisto River and several coastal plain rivers, where they have negatively

affected a previously popular fishery for native catfish and redbreast sunfish. These species are able to survive in any water in the state.

White perch (*Morone americana*)



© Gary Meszaros/Dembinsky Photo Associates

White perch have become established throughout the state and compete with white bass. White perch are native to South Carolina's coastal rivers but have been moved to upstate reservoirs and may be competing with the crappie fishery. White perch have displaced white bass, which are not native to the state but were managed as a sport fishery in upstate reservoirs.

Green sunfish (*Lepomis cyanellus*)



Green sunfish *Lepomis cyanellus*

www.cnr.vt.edu/efish/

Green sunfish are native to the central and eastern United States west of the Appalachian Mountains and east of the Continental Divide, from the Great Lakes region south to the Gulf Coast states and northeastern Mexico. Green sunfish has been introduced in Piedmont rivers and streams where it could be having an effect on native species of warmwater streams. To date, no information is available on how green sunfish have affected native fish fauna in Piedmont rivers and streams.

Asian Carp

The term Asian carp refers to several species of carp that have been imported from Asia for specific aquaculture purposes. All Asian carp are illegal for use in South Carolina except for triploid (sterile) grass carp, which are carefully regulated. Below are summaries of each species:

Silver Carp (*Hypophthalmichthys molitrix*) is a species native to the rivers of Asia, which was imported into the U.S. during the 1970's. It was to serve as a filter feeder in catfish aquaculture operations of the Gulf Coast area or in other waters with high nutrient loading. It was believed at the time it could be used as an extra crop to be used as a food fish as well helping improve water quality. It was brought in at least once to South Carolina for a Clemson University research project in a dairy farm pond in the Pendleton area. This was in the 1970s when Asian carp were still considered to have great potential. They have not been used again in South Carolina.

The silver carp is a filter feeder of phytoplankton throughout its life and can obtain a size of 39 inches and 60 pounds. It has already spread throughout the Mississippi River Basin and could enter the Great Lakes. There is great concern for this species competing with native species. It has also gained notoriety as the “flying carp” which has been noted on the news video highlights in the past several years. They have become a physical hazard to people boating in the Mississippi River Drainage.

Silver carp are under review for a proposed rule by the U.S. Fish and Wildlife Service to list it as an injurious wildlife species under the Lacey Act. This would prevent any interstate transfer of the species.

Bighead carp (*Hypophthalmichthys nobilis*) is a species native to the rivers and lakes of Asia. It was first imported into the US to help improve water quality in catfish aquaculture operations in the 1970s. It was thought it could also be used as

a secondary crop food fish. They have become well established in the Mississippi River basin through escapement or stocking. They are reaching very large biomass in these systems. They are filter feeding zooplanktivores that can attain a size of 60 inches and 110 pounds. The concern with this species is the impact of their competition with native species for food. They have not been reported in any waters of South Carolina, but are believed capable of establishment in our large rivers and lakes.

Black Carp (*Mylopharyngodon piceus*) is a carp species native to the rivers of East Asian countries. At first, it was imported into the US by accident with grass carp shipments into the southern states. In the 1980s, it was intentionally brought in to control snails, which host parasites detrimental to catfish in culture ponds of the Mississippi Delta region. They have escaped or were introduced into the Mississippi River basin. The concern with this species is the potential to negatively impact native mussels, snails and aquatic invertebrates. Some of these natives are threatened or endangered species. Black carp can grow to a size of 48 inches and 71 pounds. In South Carolina, an aquaculture operator did apply a number of years ago to import these carp for snail control in his catfish ponds. His application was turned down by the South Carolina Department of Natural Resources due to concerns of escapement and ecological damage to our native species.

Grass Carp (*Ctenopharygodon idella*) is an Asian carp species native to the rivers of Russia and China. It was first introduced into the US for biological control of nuisance aquatic vegetation in the early 1960s. Grass carp have been stocked into many ponds, lakes and rivers, and have established reproducing populations in some large rivers and connected lakes. They are now found throughout much of the country. They can reach 59 inches and 99 pounds. They eat a wide variety of vegetation and have the potential to eliminate habitat for fish spawning, nursery and feeding. In South Carolina, they have approved use as biological control agents for nuisance aquatic vegetation. This species is regulated

and tested by the South Carolina Department of Natural Resources as they are brought in by growers from other states. Only triploid grass carp are permitted. This insures that they are sterile and cannot reproduce if escapement occurs.

Asian Swamp Eel (*Monopterus albus*)

Asian Swamp Eel is a species native to Asia from India to China where it is considered a food fish. It is common in the rice growing areas where it has other common names such as rice paddy eel. Introduction into South Florida was believed to be through the aquarium trade or from fish markets. It has also been discovered in North Georgia along the Chattahoochee River drainage. The Asian swamp eel is a general predator, which can grow to 100 cm in length. The greatest concern is the impact on native fishes, herpefauna and aquatic macroinvertebrates. This species also has the ability to cross land to reach other water bodies from established areas. It can withstand poor water quality and drought and has been found to be very difficult to eradicate. There has been no documentation of this species in South Carolina, but it is believed it could become established in our waters.

Northern Snakehead (*Channa argus*)



Northern Snakehead is a species native to China, Korea and Russia. It is considered a food fish in its native waters. It has likely been introduced into the United States through Asian fish markets. Some fish have been found in the aquarium trade. It has been located

in Florida, Maryland, California, Virginia and possibly North Carolina. It has established a reproducing and expanding population in the Potomac River system where Virginia and Maryland are trying to eradicate or at least control it. Northern snakehead is a predatory species, which is mainly piscivorous as an adult. They could impact native species where introduced. This species can reach a size of 33 inches and prefers slow to stagnant waters. It can survive oxygen depleted waters since it is an obligate air breather. It is believed they could establish in South Carolina waters, since they have survived in states to the North and South of our state.

Insects

Asian tiger mosquito (*Aedes albopictus*)



Aedes albopictus, the Asian tiger mosquito, has perhaps been the most successful aquatic invasive species to encroach into South Carolina over the past eighteen years. First documented in South Carolina in 1988, the species has spread rapidly and now occurs in all 46 counties. First found in the United States in Texas in 1985, *Ae. albopictus* is thought to have entered the country through the worldwide distribution of used tires. This species is a competent vector of many viruses including dengue fever, Eastern equine encephalitis, potentially St. Louis and La Crosse encephalitis, as well as dog heartworm. The life cycle of *Ae. albopictus* is closely associated with human habitat and it breeds in containers of standing water. It is a very aggressive daytime biter with peaks generally occurring during early morning and late afternoon. It feeds on a number of

hosts, including man, domestic and wild animals. It generalized feeding behavior contributes to its vector potential. (Dr. Chris Evans, SCDHEC)

Asian mosquito (*Ochlerotatus japonicus*)



Ochlerotatus japonicus, an Asian species generally found in Japan and Korea, was first documented as occurring in South Carolina in 2003. Initially found in northern Greenville County, the species has spread to nine South Carolina counties, primarily in the upper Piedmont and Central Midlands (Oconee, Pickens, Greenville, Anderson, Laurens, Union, Cherokee, York and Richland). *Oc. japonicus* was first detected in the United States in 1998 in New York and New Jersey. Since its first discovery, the species has rapidly expanded its range. By the end of 2003, the species had been documented as occurring in 19 states, primarily on the eastern seaboard. The species is suspected of being a vector of Japanese encephalitis, West Nile virus and St. Louis encephalitis. The larval habitat for the species is similar to that of *Ae. albopictus*, with larvae typically being found in small-volume containers such as bird baths, buckets, plastic containers, wheelbarrows, animal watering containers and tires. While not considered an aggressive human biting mosquito, the species is primarily a day and early evening biter. (Dr. Chris Evans, SCDHEC)

Crustaceans

Red Swamp Crayfish (*Procambarus (Scapulicambarus) clarkii* (Girard, 1852))

Red swamp crayfish are native to Gulf Coast drainages and the lower Mississippi River drainage (northern Mexico to Florida and north to Illinois) and were introduced to many states within the U.S. (McLaughlin et al., 2005). Introduced into South Carolina as an aquaculture species in 1978 (Pomeroy and Kahl, 1987; Mazlum and Eversole, 2005), it

has since escaped into the wild either from its own migrations, bait-bucket releases, or other accidental/intentional releases. It has been reported to occur across much of South Carolina (Eversole and Jones, 2004), but detailed distribution information is not known. Definitely occurs in the Saluda River below Lake Murray (W. Poly, pers. obs.).



Red Swamp Crayfish

Mollusks

Viviparid snails



Viviparus georgianus *Viviparus subpurpureus*



Bellamya japonica

photos courtesy of Rob Dillon, College of Charleston

The ecological and economic impacts from non-native snails in South Carolina are not well known. Two species of particular concern include *Viviparus subpurpureus* and *Bellamya japonica*. Millions of viviparid shells have been identified on beaches at Lake Marion, one of the Santee Cooper lakes. The shells were a mixture of

approximately 95 percent *Viviparus subpurpureus* and 5 percent *V. georgianus*. This is the first known report of *V. subpurpureus* in an Atlantic drainage, as well as the first report that this species can be invasive.

Native to Southeast Asia, *Bellamya japonica* (sometimes misidentified as the Chinese mysterysnail, *Cipangopaludina chinensis malleata*) was first introduced to North America in the late 1890s and has now become firmly established in the United States. Healthy populations have become established in South Carolina (Jonesville Reservoir, Lake Greenwood, and Lake Marion). The species is probably spread mainly by water garden hobbyists.

Channeled Apple Snail (*Pomacea canaliculata*)

The channeled apple snail is a large aquatic snail native to South America. Shells of channeled apple snail are spherical with 5 to 6 whorls and can reach a width of more than two inches and a height of three inches. The shells are yellowish to brown in color and the aperture is large and oval to round. Egg masses range in number from 200-600, have a characteristic pink color, and are generally loosely attached to each other and to another object above the water line. The snail reaches sexual maturity at around 1 inch.

Reproduction occurs year round and reaches its height during the spring and summer.

The snail feeds on aquatic vegetation, which many native species depend on for foraging and shelter.

Breeding populations of the channeled apple snail occur in Florida, Texas, California, Hawaii, North Carolina, Ohio, Indiana, and most recently in Georgia. The closest populations to South Carolina are located in the Satilla River Basin in southern Georgia.

In the 1980s, the channeled apple snails were introduced to Taiwan in order to start an escargot industry where they escaped to rice fields. They quickly spread around Asia and to Hawaii. They are commonly sold in the aquarium and pet trade industry and are becoming popular in the water gardening industry. In some instances, apple snails are being sold in biological supply house catalogues and are provided to teachers for

educational purposes. It has also been noted that some individuals have introduced apple snails as a means of vegetation control in private ponds. They can be accidentally released from water gardens because of the apple snail's ability to escape and travel over land. Once released, apple snails can be transported by birds, on boats, on aquatic vegetation, and by natural water movement.

As with most invasive species, the channeled apple snail has the ability to alter the native ecosystems it invades. They reproduce quickly and have very few predators so they spread quickly. Often they compete with native species for habitat and available resources. Channeled apple snails feed on all types of aquatic vegetation and could greatly impact the aquatic plant community. Currently there are no biological control agents and no chemical agents that selectively eliminate the channeled apple snail so control options are limited to hand removal.



Zebra mussels (*Dreissena polymorpha*)

While zebra mussels have not yet been found in South Carolina, they occur nearby (near Knoxville, Tennessee) and threaten to invade the state's waterways. A statewide zebra mussel risk assessment indicated that water quality conditions (soft water) should inhibit the growth and reproduction of zebra mussels in most of the state; however, water quality conditions are more favorable in the middle Piedmont region from York County to McCormick County, the Intracoastal Waterway near Georgetown, portions of the Cooper

and Ashley rivers near Charleston, and the Savannah River near Savannah, Georgia (de Kozlowski, et al., 2002).



The growth of zebra mussel populations can cause significant ecological consequences throughout an aquatic community. They are efficient filter feeders, so can remove large amounts of phytoplankton from the water, which serve as the primary energy source in most aquatic ecosystems. Zebra mussels like to attach and colonize on hard surfaces including native clams and mussels. Clams covered with zebra mussels cannot open their valves and as a result are smothered, thus reducing the rich diversity of the mussel and clam community. When zebra mussels impact aquatic communities, recreational angling usually suffers. Unprotected docks, breakwalls, boat bottoms and engine outdrives can be rapidly colonized. Economically, industries, including hydropower production facilities and water utilities that take water from inland waters, would incur costs of removing zebra mussels from clogged intake pipes.

Asian clams (*Corbicula fluminea*)



The Asian clam was first reported in the United States in Washington's Columbia River in the 1930s. It was likely introduced intentionally for harvest and consumption purposes (Counts, 1986). *Corbicula fluminea* spread mostly through human activities, such as bait bucket dumping, aquaria releases into streams or canals, and intentional releases by people who bought the clams at food markets. Asian clams may also have been a contaminant in an imported aquaculture species. Another pathway for dispersal is the passive movement of larvae in water currents. Since then it has spread across the country, with the first reports of it in South Carolina were from the Pee Dee River in the late 1960s or early 70s. From there it has spread to the Savannah River, the Santee Rivers, and throughout the state. Ecological impacts of Asian clam infestations include the altering of benthic substrate and increased competition with native species for food and habitat resources. Periodic massive dieoffs of the Asian clam have been linked to mortality of native freshwater mussels (Scheller, 1997), and the clam has been blamed for the decline and local extinctions of several native freshwater mussel species (Williams, 1997). Asian clams also serve as a food source for many species favored by fishermen, including largemouth bass and freshwater drum. But this benefit is outweighed by the economic burden borne by industries and municipalities. Economically, the Asian clam introduction has been related to biofouling of power plant water intakes and other municipal and industrial water intake and supply systems. In some parts of the United States, *C. fluminea* also causes problems in irrigation canals and pipes (Foster et al., 2000).

Marine/Estuarine Animals

Fishes

Red lionfish (*Pterois volitans*)



photo courtesy of Dany Burgess



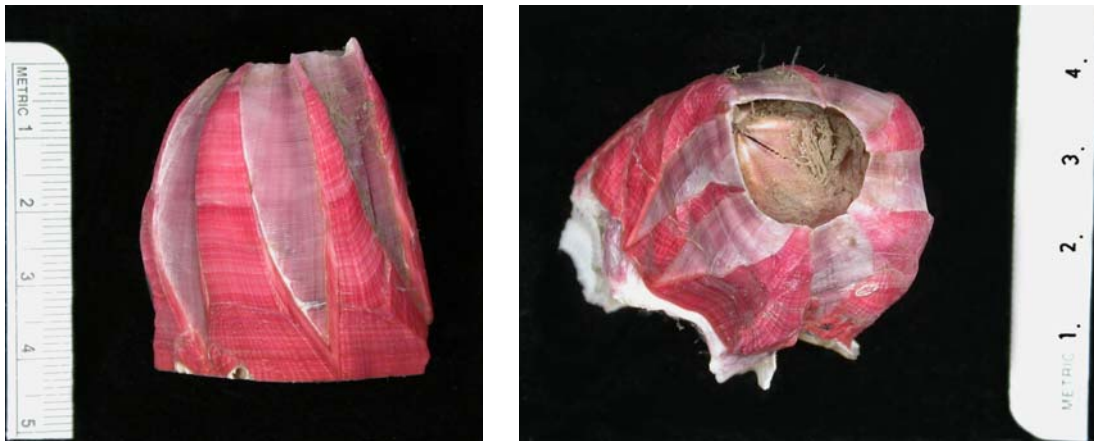
photo courtesy of NURC, UNC Wilmington

The red lionfish, *Pterois volitans*, is a venomous scorpionfish indigenous to the Indian and western Pacific oceans. It inhabits lagoon and seaward reefs to depths up to 50 m (Myers, 1989; Lieske and Myers, 1996) and constitutes one of the top levels of the food chain (Fishelson, 1975). The lionfish that were first reported in 1992 in the United States near shore waters off Palm Beach, Florida, are believed to be unintentionally released from private aquaria (Courtenay, 1995). If so, that is the first time that an aquarium release has been identified as the likely source of a successfully established non-native marine fish (Semmens et al., 2004). Since 1992, confirmed sightings of adult lionfish have steadily increased, spreading northward from Florida to include the coastal waters of Georgia, South Carolina, and North Carolina. The first confirmed sighting on live-bottom reefs in the western North Atlantic occurred off North Carolina in August 2000 (Whitfield et al., 2002). The presence of adults, coupled with substantiated reports of juveniles captured in estuaries of New York, New Jersey, Rhode Island, and Bermuda, indicate that red lionfish are spawning off the southeastern coast of the U.S. and the resulting larvae are being transported northward via the Gulf Stream (Ruiz-Carus et al., 2006). Environmental stability and a diverse and abundant food supply may have enabled red lionfish to persist in the biologically productive shelf-edge areas off the southeastern U.S. With few known predators and apparently successful reproduction, populations of red lionfish in the South Atlantic Bight could increase rapidly. Future research efforts

should include detailed studies of life history of this species, with emphasis on examining reproductive state and food habits, in order to be able to assess reproductive potential and trophic impacts on reef communities. Genetic studies should be conducted in an attempt to determine the Indo-Pacific source of introduced red lionfish and the dispersal patterns in their new range (Meister et al., 2005).

Crustaceans

Barnacle (*Megabalanus coccopoma*)



photos courtesy of the Southeastern Regional Taxonomic Center

The large tropical Eastern Pacific barnacle, *Megabalanus coccopoma*, was first collected from South Carolina waters in the Folly River, near Charleston Harbor, in late October, 2006. Since that time, its presence has been documented on Edisto Island, Kiawah Island, Folly Beach and Sullivans Island. Known historically from the coast of Baja California through Central and South America to the Gulf of Guayaquil in southern Ecuador, the species appeared as far north as San Diego, following a warm “El Niño” event in 1982-83 (Newman and McConnaughey, 1987). The species has also been found in Belgium (Kerckhof, 2002), and became established in southern Brazil, as well (Newman and McConnaughey, 1987). In 2002, *M. coccopoma* was found in Louisiana, and even more recently, in 2006, on the Atlantic coast near St. Augustine, FL and Savannah, GA (USGS website). Known to favor “new” structures for settlement, this barnacle may have significant impact on boat owners by fouling hulls and settling on propellers and driveshafts. It also prefers fairly high salinities, and has been found in large numbers

fouling coastal navigation buoys in Georgia (Alan Power, pers. comm.) and Belgium (Kerckhof, 2002). Like other barnacles, *M. coccopoma* is a gregarious settler, and since it reaches a much larger size than native species of barnacles in South Carolina, it may require greater maintenance efforts on surfaces exposed to coastal and high salinity estuarine areas, if it becomes established here.

Isopod (*Synidotea laticauda*)



photos courtesy of the Southeastern Regional Taxonomic Center and David Bushek, Haskins Shellfish Research Laboratory, Rutgers University

The taxonomy of this small invasive crustacean is currently the subject of debate (e.g. see Moore, 2004; Bushek and Boyd, 2006); however, regardless of whether the species is native to the eastern (*Synidotea laticauda*) or western (*S. laevidorsalis*) Pacific, in either case it is now successfully established on the Atlantic coast of the United States. Its appearance in 1999, both in South Carolina and New Jersey, and its absence from the intervening coastline strongly suggest human-mediated introductions, probably associated with the maritime industry in ballast water or as a hull-fouler. Although not much is known of the abundance and distribution of the species in South Carolina, it is generally found fouling buoy and crab pot lines and floating docks in mesohaline to polyhaline reaches of coastal waters. To date, it has been found in the Stono, Ashley and Wando Rivers in the Charleston Harbor area, in the Dawho River off the North Edisto, and in the Combahee River. In Delaware Bay, it shows seasonal peaks in abundance, and it can become extremely numerous during the warm months, reaching densities as high as 30,000 in one week in a 2'x3' tray containing oysters and mussels that were suspended

from a dock (Bushek and Boyd, 2006). It is most commonly found among hydroids, bryozoans and algae of fouling communities.

Green porcelain crab (*Petrolisthes armatus*)



photo courtesy of the Southeastern Regional Taxonomic Center

The green porcelain crab, *Petrolisthes armatus* (Gibbes, 1850), is widely distributed in the eastern Pacific, from the Gulf of California to Peru. In the Atlantic, it is found in tropical western Africa, Ascension Island, Bermuda, the Bahamas, throughout the Gulf of Mexico, the West Indies and Caribbean, and South America to southern to Brazil. As early as the 1930s, the species was collected from the Florida Atlantic coast at Biscayne Bay and Miami Beach, and it was found on worm reefs south of Cape Canaveral in the early 1970s. Since that time, it has become well established in the Indian River system, however it was not reported north of Cape Canaveral until 1994, when faunal surveys on St. Catherines Island, Georgia revealed its presence there. After its initial discovery on St. Catherines Island, the species increased dramatically in abundance there, becoming the dominant decapod crustacean on rocky substrates and tidal creek oyster bars by the following spring. In South Carolina, it was first observed in low densities in the spring of 1995 at various locations, becoming quite abundant by the fall. It is now well established on rocky rubble, oyster reefs and other shallow subtidal and intertidal habitats throughout

Georgia and South Carolina, as far north as Murrells Inlet, S.C. During the recruitment season, densities of *P. armatus* greater than 20,000 indiv./m² were observed on collectors deployed for one month in its preferred habitat, and larval stages have been collected from the plankton of coastal inlets in Georgia. There are many potential pathways for its introduction, both natural and human-assisted. Although there is no data to suggest which of these is the principal pathway, there are several possibilities, including transport in ballast water from foreign and domestic ports and among cultured mollusks transported from localities within its previously established range. Some of the potential ecological impacts of this small filter-feeding crustacean on coastal waters of the South Atlantic Bight have been elucidated recently in the dissertation research of Hartman (2003) and Hollebone (2006).

Spiny hands crab (*Charybdis hellerii*)



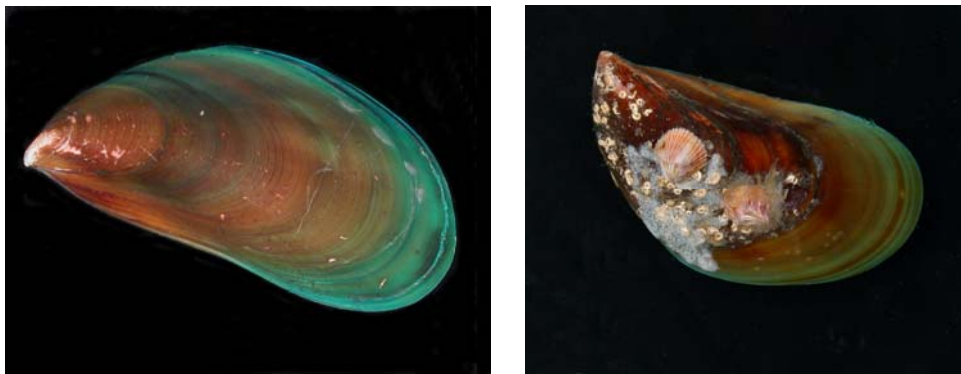
photo courtesy of the Southeastern Regional Taxonomic Center

The swimming crab *Charybdis hellerii* was introduced to the Caribbean Basin from its native range in the Indo-Pacific, probably via shipping routes through the Suez Canal to the Mediterranean, and ultimately across the Atlantic Ocean (Campos and Türkay, 1989). In the western Atlantic, it was first observed in 1987 in Cuba, Venezuela and Columbia. Lemaitre (1995) also attributed its presence in the Caribbean to transport in ship's ballast

water, and he was the first to document its occurrence in U.S. waters, reporting its establishment in the Indian River system of Florida by 1995. In 2001, it was documented in French Guyana by Tavares and Amouroux (2003), who also reported its earlier presence as far south as Ubatuba, Brazil. In 2001, a specimen of *Charybdis hellerii* was discovered in storage in the collection of the Southeastern Regional Taxonomic Center at the Marine Resources Research Institute in Charleston, SC. This specimen had been stored undetected since its capture in the Folly River, SC in 1986, making it the earliest known specimen taken from the Atlantic Ocean. Since the discovery of the Indian River population, *C. hellerii* has been collected occasionally from shallow coastal waters of the South Atlantic Bight between Crescent Beach, Florida and Core Banks, North Carolina. The greatest number of specimens in that region has been found in the Winyah Bay estuary of South Carolina (including a gravid female and a mated pair) and in shallow waters off the Core Banks, North Carolina (all juveniles). This species represents the third known introduction of a marine decapod on the North American Atlantic coast. Little is known of its potential effects on the resident species in its preferred habitat.

Mollusks

Asian green mussel (*Perna viridis*)



photos courtesy of the Southeastern Regional Taxonomic Center

The Asian green mussel, *Perna viridis*, is a nuisance even within its native range in the Indo-Pacific, largely due to its size and capacity to grow rapidly and reach maturity at a young age. The species was transported from the Indo-Pacific to Trinidad in 1990, via ballast water or hull-fouling communities on ocean-going vessels. By 1993 it had become established in Venezuela, and in 1999 it was discovered in Tampa Bay, FL, where it

obstructed flow through cooling water intakes at several power plants. Subsequently, the mussel made its way to the Atlantic coast of northeast Florida, and by the fall of 2003 it had extended its range northward as far as the mouth of the Savannah River. Although a number of laboratory and field studies have reported thermal tolerances of *Perna viridis*, there is no consensus on the likely limits to its northward expansion along the United States east coast. Despite predictions that it would not survive north of Georgia, it has recently been found in the Folly River (August, 2006) and Charleston Harbor (October, 2006). The capacity of the species to increase its thermal tolerance with prolonged acclimation and the potential effect of genetic selection for cold-tolerant individuals remains unknown. The impacts of this species have the potential to be severe. In addition to hampering the effectiveness of cooling systems, it is also notorious for fouling navigation buoys, floating docks, piers and pilings. Ecological studies in Florida have shown that *P. viridis* is also detrimental to intertidal oyster reefs, where it displaces adult oysters and reduces the density of juvenile oysters. The efficacy of various methods to exterminate it has been studied, with the goal of mitigating the financial burden it imposes due to the fouling of power plant intakes and other infrastructure exposed to seawater.

Charrua mussel (*Mytella charruana*)



photo courtesy of the USGS

Although this species has not yet been found in South Carolina waters, the distribution patterns of several nonindigenous species suggest that *Mytella charruana* is likely to spread north into the state in the near future. In the same family that includes the invasive green mussel and several native marine mussels, *M. charruana* poses the potential problem of fouling structures submerged in seawater. Native to the Atlantic (Venezuela to Argentina) and Pacific (Mexico, El Salvador and the Galapagos Islands) Oceans, large numbers of the charrua mussel first appeared in the United States in 1986 in the seawater intake pipe of a power plant in Jacksonville, Florida (Boudreaux and Walters, 2006). Although cold winter temperatures eliminated that population in 1987, it has since returned to the Indian River Lagoon, where it has increased in number since its discovery in 2004, suggesting that a reproducing population has become established there. The mussel has been discovered most recently in Liberty County, Georgia, near Savannah, which is the most northerly record of its occurrence to date (Alan Power, pers. comm.). The population there is a large reproducing one, arousing concern that it might cause economic hardship due to its fouling ability and ecological alteration due to competition with native shellfish species.

Pathways of Introduction

Understanding the mechanism, or pathway, by which non-native species enter the state is important in order to prevent or minimize additional introductions. An analysis of the USGS Center for Aquatic Resources Studies database (Fig. 4), which only includes aquatic animals, indicates that the major pathways for non-native species to enter South Carolina are stocking (44%), aquarium releases (14%), shipping (11%), and bait releases (10%). These sources are comparable to other states in the southeast. Except for Florida, stocking is the greatest source of introduced non-native species for all other southeastern states. Stocking averages 43% for other southeastern states with ranges from 30% in Louisiana to 56 % in Tennessee (Table 1). These same states site stocking, aquarium releases, bait releases, and aquaculture as the top sources for introduced species.

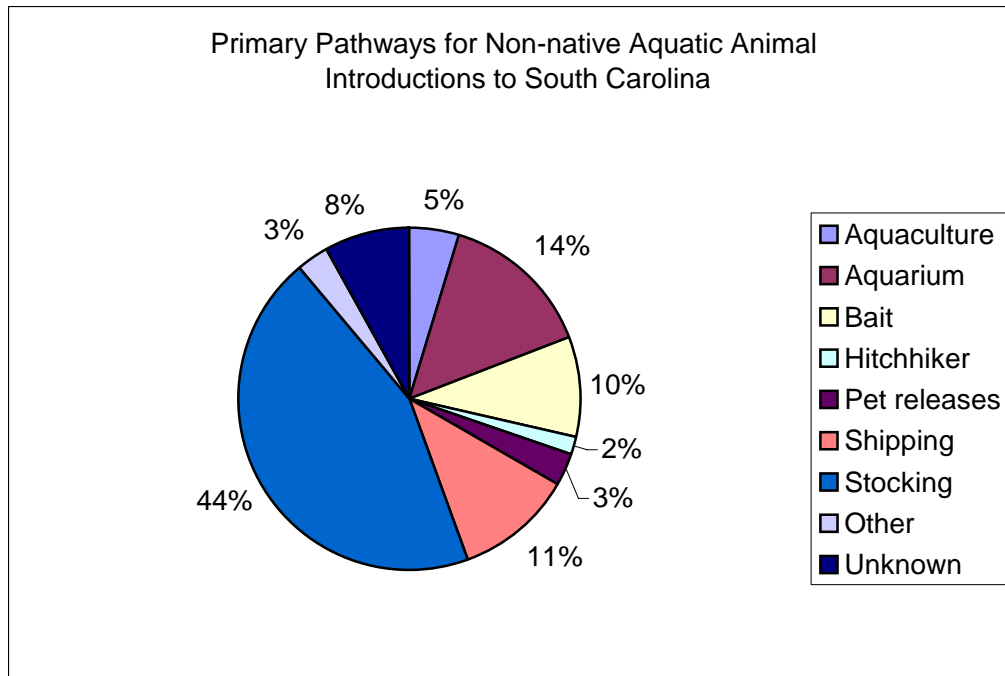


Figure 4.

State	Stocked	Aquaculture	Bait	Aquarium	Shipping
AL	46	13	17	5	4
FL	13	11	4	36	11
GA	42	7	26	8	3
LA	30	23	8	15	7
MS	40	14	8	10	6
NC	42	3	24	9	6
SC	44	5	9	14	11
TN	56	5	18	4	1
TX	48	4	11	18	4
VA	41	5	21	5	9
Average	40.2	9	14.6	12.4	6.2

The original pathway of introduction for many non-native aquatic plant species into South Carolina is unknown (Fig. 5). Furthermore, many may have arrived by more than one means. For example, hydrilla is an aquarium plant that was probably introduced by hitchhiking on a boat from Florida. However, it is also a popular aquarium plant that could have been introduced by the disposal of aquarium contents into a lake. Once in the

state, this species can be further spread by hitchhiking on boats and waterfowl, or introduced intentionally by man. Based on analysis of data provided to the USGS Center for Aquatic Resources Studies on aquatic plant introductions to South Carolina, the primary pathways are aquascaping, which includes plant nursery sales for residential water gardens and commercial “waterscaping” (44%), aquarium releases (17%), and hitchhiking (9%).

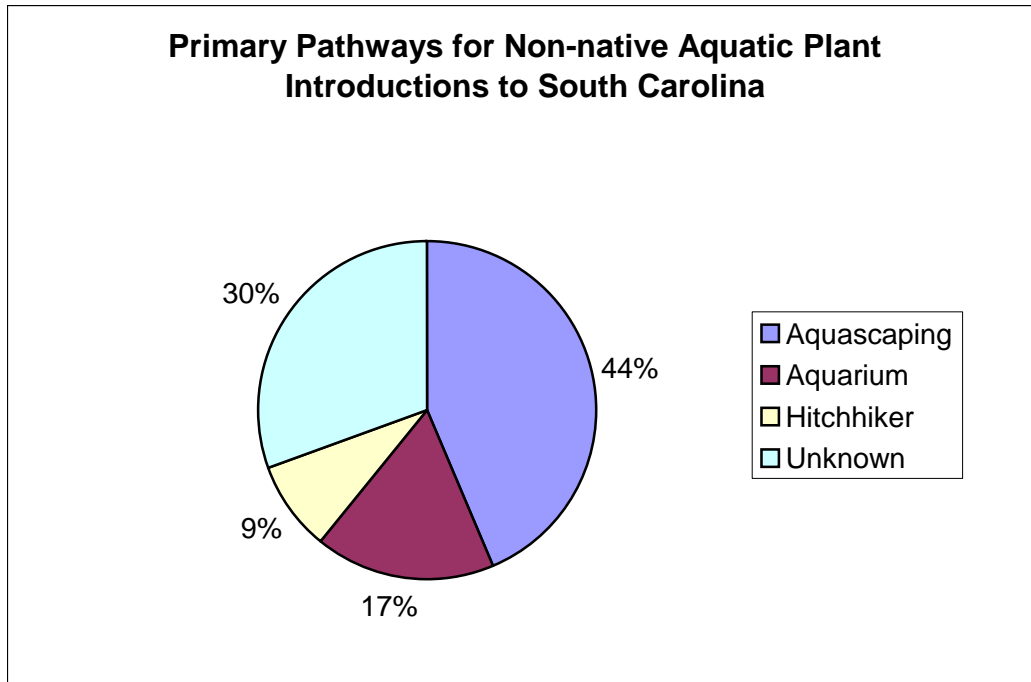


Figure 5.

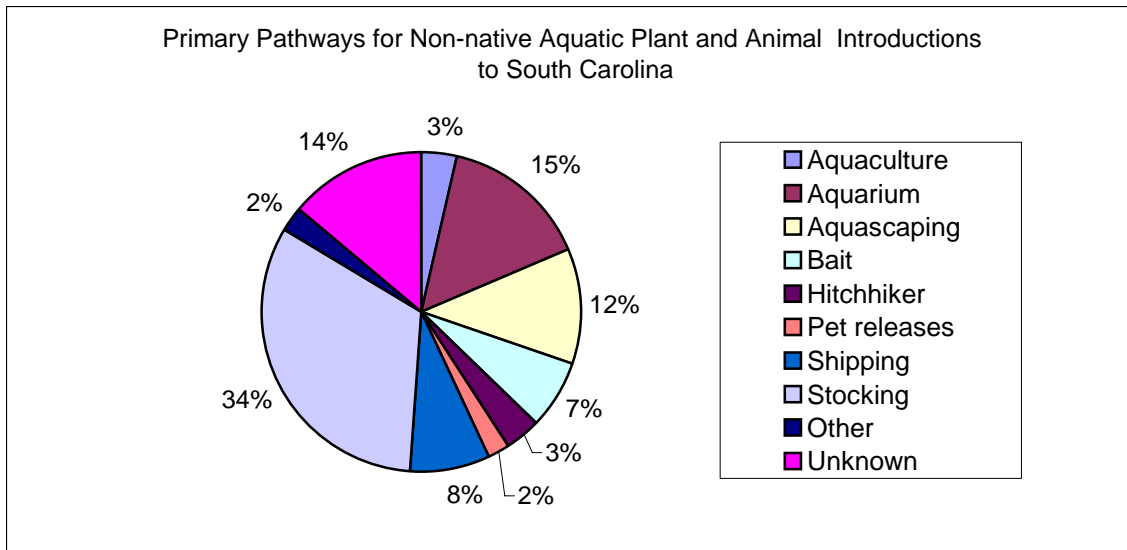


Figure 6.

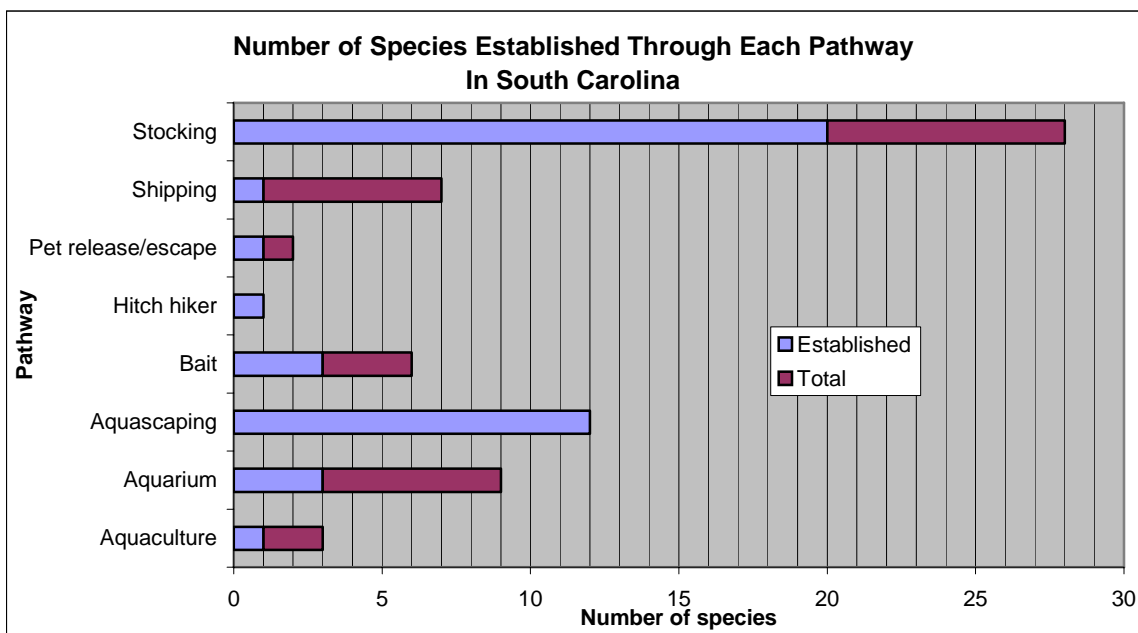


Figure 7.

Stocking

An analysis of how non-native species originally enter the state highlights the fact that the primary pathway has been the intentional stocking of fish (37%). This should not be

too much of a surprise since the largest group of non-native species introduced into South Carolina have been fish (68%). Prior to 1970s, stocking of game fish by the S.C. Department of Natural Resources (formally the S.C. Wildlife Department) and by most fish and wildlife agencies nationwide was standard operating procedure. The philosophy at the time was to stock game fish in public waters that provided anglers with an exciting and varied fishing experience. The potential impact of those stockings on native fishes and other aquatic organisms was not weighed as heavily as it is today. Fortunately, most stockings were with species native to North America and usually to the southeast. Because these species were carefully selected to live in South Carolina waterways, this pathway has one of the highest percentages of species establishment after introduction (Fig. 6). Stocking non-native fish in South Carolina is now limited to the introduction of sterile grass carp and tilapia for aquatic plant control, white bass in major reservoirs, and smallmouth bass, rainbow and brown trout in rivers and reservoirs. These species are adding sportfish or biological controls into waters without causing detriment to other species.

Another pathway of introduction is the intentional stocking of species by anglers. The spotted bass has entered and been established in our upstate reservoirs by this method. There is competition with native species in these reservoirs. The hybridization with our native redeye bass has also caused concern. At the present time, there are no laws against moving fish that are established in the state. One can move fish without a stocking permit into ponds. Fish can escape from their ponds and become established in public waters.

Aquascaping (water gardens, plant nurseries)

This pathway is the largest source of introductions of non-native aquatic plants into the state (44%). The water garden industry appears to be increasing as more and more homeowners build backyard ponds and water features. In recent years, the requirement to construct stormwater detention ponds on commercial property has lead to an increase in aquascaping these structures in high visibility areas. Clemson Department of Plant Industry reports an increase in the number of nurseries that carry aquatic plants for sale. Recent outbreaks of water lettuce, water hyacinth, and giant salvinia in South Carolina

waterways have all been tied to homeowner introductions of plants purchased for use in water gardens. Several species, including those listed above, are included on the State or Federal Noxious Weed lists, so are illegal to import and sell in South Carolina. Most commercial plant nurseries are familiar with the law and do not sell illegal plants. However, internet sales of these species and sales by individuals at flea markets appear to circumvent state and federal laws and efforts to prevent their introduction.



Aquarium/ Pet releases and escapes

Combined, aquarium and pet releases make up 15% of all non-native introductions to the state (Fig. 5). Department of Natural Resources fishery biologist routinely capture or receive reports from anglers of South American pacu caught in state waters. This relative to piranha is purchased as an aquarium pet and often released into the wild after they out-grow their aquarium. While it is not well documented, it is possible that introductions of the aquatic weeds hydrilla and Brazilian elodea also came from aquarium releases. These are both popular aquarium “oxygenating” plants. Other examples of introductions from this source are Asian snails, lionfish, and a variety of small tropical freshwater and saltwater fishes. Fortunately, only about one-third of all aquarium species identified in South Carolina waters have established populations (Fig. 6). Since many of these species are tropical or subtropical they may survive South Carolina winters by taking refuge in spring-fed waters that do not get as cold in the winter or in thermal effluents of power

plants or other industrial facilities. No comprehensive information is available on the distribution of aquarium fish or other pets in South Carolina.

Shipping (Maritime)

Commercial shipping has been identified as the fourth largest pathway for the introduction of non-native aquatic species in the state. Nine percent of all non-indigenous aquatic species have arrived by this pathway. Commercial shipping is big business in South Carolina. The Charleston Customs District ranks as the nation's sixth largest in dollar value of international shipments, with cargo valued at more than \$53 billion annually. State ports pump over \$23 billion into the state economy and generate \$2.5 billion in state and local taxes.

Four major ports provide access to state waterways: Charleston, Georgetown, Port Royal, and Savannah (Georgia). In 2005, the Port of Charleston was the busiest container shipping port along the Southeast and Gulf coasts. In fiscal year 2006, the State Ports Authority alone served 2,167 ships and barges at its terminals in Charleston, Georgetown and Port Royal.

The principal way that aquatic invasive species can enter state waters through shipping is by the discharge of ballast water while ships are in port. Ballast water is pumped in to the hull of a ship to help stabilize the ship and keep it upright while carrying cargo. This water is often discharged at the receiving port after the cargo is unloaded. Each ship may take on and discharge millions of gallons of water. Ballast water taken on in foreign ports may include an abundance of aquatic plants, animals, and pathogens not native to South Carolina. If discharged into state waters, these foreign species may become problematic.

In addition to ballast water discharge, another important source for the introduction of non-indigenous organisms is the fouling community that grows on the hull, rudder, propellers, anchor, anchor chain or any other submerged structure of vessels that are not properly cleaned or maintained. Historically, such fouling communities were composed of massive layers of a variety of organisms, both attached and merely entrained in or

living on that growth. Although such extensive growth is not as common on seagoing vessels in recent times, it still provides an opportunity for worldwide transport of fouling organisms, particularly on towed barges and other structures like mothballed ships and exploratory drilling platforms. Recent invasions by a number of coastal invasive species offer evidence that hull fouling remains a viable pathway for non-indigenous introductions.

The U.S. Coast Guard has developed a nationwide Ballast Water Management Program and is responsible for enforcing it in South Carolina. However, a number of provisions in that program allow the discharge of untreated ballast water under certain circumstances, and ballast water discharge continues to be of particular concern at the ports of Charleston, Georgetown, and Savannah. All three of these areas were identified in a 2002 zebra mussel risk assessment as sites in which water quality was suitable to support zebra mussels (de Kozlowski, et al. 2002). Due to water quality characteristics at these sites, they are among the more probable sites for the introduction of marine, estuarine and freshwater organisms.

Bait Releases

Bait releases make up eight percent of all introductions. Bait is imported from many areas outside of the state so has the potential to be contaminated with non-native plants and animals, associated diseases, and parasites. Specifically, dead or live shrimp used for bait can carry disease that can impact native shrimp populations. South Carolina has not had a problem with other species of bait to date. Baitfish introduction of blue-backed herring occurred in late 1970s to early 1980s. Blue-back herring are native to South Carolina coastal rivers, but are causing problems when released as bait in inland reservoirs. Nonnative fathead minnows are used for bait or forage. Threadfin shad are established and not a big concern; they can be used as bait. Anglers use shad and herring as bait for striped bass and catfish fishery. There is interest in raising rudd for bait, but it is currently illegal. A number of dealers sell fish for private pond stocking and are restricted to use of approved species.

Aquaculture

South Carolina has an extremely diverse aquaculture industry. Although it is a multimillion-dollar industry, it is not large compared with other southeast states. Native hard clams (*Mercenaria mercenaria*) are cultivated in coastal areas and is the largest aquaculture industry in the state. Clams used in culture operations must be permitted through SC DNR and shipments are required to be inspected and disease certification required if seed or broodstock originate from out of state. There are regulatory concerns of diseases and “hitchhikers” entering SC through the transfer of product. There is an aquaculture interest in using shrimp, fish and oysters such as *Crassostrea ariakensis* (which is being analyzed for possible introduction in Chesapeake Bay) for bottom culture or cages along coastal and offshore areas. Saltwater aquaculture facilities raise non-native shrimp, mostly Pacific white shrimp (*Litopenaeus vannamei*) and some freshwater prawns (*Macrobrachium rosenbergii*). Native shrimp provide an important capture fishery along the coast and there is a potential for damage due to importation of non-native competitive species, genetic mixing with highly inbred production stocks, and introduction of associated diseases. SC DNR follows strict guidelines developed by USDA’s US Shrimp Farming Consortium in permitting non-native shrimp culture. Non-indigenous Australian (red claw and marron) crayfish production has been attempted in the past and is under consideration for aquaculture use in South Carolina. Australian crayfish fall under SC DNR’s non-native aquaculture permitting authority.

Freshwater species include grass carp, striped bass, crayfish, prawn and catfish. Use of triploid grass carp for aquatic weed control is permitted, under a strict SC DNR certification and permitting program. Most grass carp are spawned and reared out-of-state, then sold directly by the dealer or grown out before selling. One business in South Carolina produces them from diploids. There is a small amount of rainbow trout farming in the upstate. Rainbow trout and brown trout are stocked in South Carolina streams and lakes by SC DNR and are not native but not considered invasive. The first breeding of hybrid striped bass was conducted in South Carolina. As a cross between two species, it is also nonnative but not invasive. Other freshwater species raised include: crayfish

Procambarus clarkii (not native) and *Procambarus acutus* (native); the freshwater prawn *Macrobrachium rosenbergii* (non-native) and channel catfish (argument as to whether it is native). South Carolina permits the out of state introduction of non-native crayfish for stocking production facilities. *Procambarus clarkii* was first introduced into SC in the early 1970s and an existing population of *P. clarkii* is probably now established in SC. There is no information on what their effects could be on native fauna or on potential transfer of disease to saltwater shrimp industry.

A few production facilities raise baitfish, some saltwater, but on a small scale. Large baitfish producers in South Carolina have problems maintaining stable markets. The industry also raises golden shiners; these are not considered invasive except in small ponds where they can interfere with pond management. Known high-risk species are rudd, walking catfish, diploid grass carp, freshwater electric eel, and piranha. Many others are available that are known to be a problem from the experiences in other states. For example, silver, bighead and black carp have been a problem in other areas. Use of sturgeon in aquaculture may become a future issue due to South Carolina's endangered short nose sturgeon and Atlantic sturgeon. All proposed introductions have to go through the review system for use in research, education, aquaculture and other uses.

Fish, shellfish and shrimp diseases:

A primary concern for nonindigenous shrimp farming is disease amplification and release. Aquaculture producers are very concerned about all other unregulated pathways for introducing disease. The main risk of bringing in disease relates to saltwater shrimp. Health certification is only required for shrimp and shellfish (clams). There are five saltwater aquaculture production facilities in the state, which are competing economically with local shrimp boats and imported shrimp. Also, nonindigenous shrimp are in the markets for consumption. Consumers buy live shellfish for consumption from out-of-state sources. On occasion, they dispose of live leftover shellfish or shells and heads into the waters. In doing so, they are creating pathways for disease introduction.

There is a large industry of hard clams shipped as small seed from hatcheries in Maine and New Jersey, grown out and shipped back. There have been some issues with Virginia and South Carolina producers concerning bringing in southern clams, which are more susceptible to disease (QPX or Quahog parasite unknown). Taura syndrome, yellow head and white spot disease can be transmitted by disposal of body parts, either after human consumption or when used as bait. There is evidence of disease transmission from dead to live shrimp or other native crustaceans. Largemouth bass virus (LMBV) is not confirmed in any USACOE reservoirs. The Santee Cooper lakes are the first location where LMBV was found in the U.S.

Hitchhikers (boating)

Recreational boating is one pathway by which invasive species can both enter the state and continue to spread throughout South Carolina's waterways. The state's lakes, ponds, rivers, and coastal waters provide abundant recreational opportunities for boaters. In fact, South Carolina ranks eighth nationwide for the total number of registered boats and third in the number of registered boats per capita (1 boat per 10 people). The transportation of boats and their trailers between water bodies presents a risk of introduction through hull fouling, entanglements, and water discharge from bilge pumps and bait buckets. By not thoroughly washing or rinsing boats and boat trailers, boaters can easily transport aquatic weeds from one water body to another. The use of recreational boats for fishing poses the additional risk of the release of imported bait species or species that serve as hosts for nonindigenous organisms.

Other Pathways

- Intentional releases/planting of illegal aquatic vegetation.
- Ocean currents bringing stuff up from Florida.

Jurisdictions and Responsibilities

State Entities

South Carolina Department of Natural Resources (SCDNR)

The Department of Natural Resources is involved in several programs that directly or indirectly manage aquatic invasive species. The Land, Water and Conservation Division administers the Aquatic Plant Management Program, which is responsible for statewide management of invasive aquatic plants in public waters. It develops annual statewide aquatic plant management plans, coordinates control activities, implements prevention/public education efforts and identifies research needs. Program staff have taken the lead on many aquatic invasive species management activities in the state.

The Wildlife and Freshwater Fisheries Division is responsible for restricting the importation and aquaculture of certain freshwater fish species in the state. It administers the Sterile Grass Carp Permit Program that inspects all sterile grass carp shipments into the state to help ensure that only sterile grass carp are released into public waters.

The Marine Resources Division administers programs that regulate the importation and aquaculture of certain marine organisms. The program is responsible for commercial fisheries in saltwaters of South Carolina, including permitting, scientific collection permits, nonindigenous importation, legislation and policy. Outreach is provided regarding regulatory responsibilities, data collection and survey. The fisheries management program does fishery-dependent data gathering.

The Outreach and Support Services Division administers natural resource education programs for public schools, teacher workshops and agency communications. It also administers the Clean Vessel Program, which is funded through a Sport Fish Restoration Grant from the U.S. Fish and Wildlife Service. The program's goal is to promote pumpout facilities statewide to minimize the effects of vessel sewage pollution and educate the public of the effects of vessel sewage on the aquatic environment. The program plans to include aquatic invasive species as part of their public education and vessel inspection information. The program was developed through close coordination between SCDNR and SCDHEC. The agency's Natural Resource Conservation officers enforce game and fish laws and are authorized to enforce all state laws including those by other state agencies.

South Carolina Aquatic Plant Management Council

This 10-member board was established by law in 1990 to provide interagency coordination and serve as the principal advisory body to the SCDNR on aquatic plant management and research. The council establishes management policies, approves all management plans and advises SCDNR on research priorities.

South Carolina Department of Agriculture

The State Department of Agriculture administers the State Noxious Weed Act, including enforcement of the State Noxious Weed List that features several invasive aquatic plant species. It has a limited role in resource management, with more activities focused on agricultural marketing, promotion and regulation. The department has authority to stop movement of materials through commercial channels, including sale of plants by pet stores and water garden distributors. It can place quarantines through the Commissioner of Agriculture. The department can use regulatory power to help resource managers control aquatic nuisance species.

Department of Plant Industry, Clemson University

The Clemson University Department of Plant Industry (DPI) regulates plant pests throughout the state. The Department's regulatory authority is delegated by The State Crop Pest Commission (SCPC). It inspects and regulates nurseries, nursery stock dealers and agricultural producers, and administers the State Crop Pest Act, including the enforcement of state crop pest list. The state crop pest list comprises all illegal state and federal species, including several invasive aquatic plant species. The DPI provides inspection and certification services to agricultural producers to assure they meet pest free requirements for sales, distribution, and exportation of plant products. There is a memorandum of understanding between the DPI and the Department of Natural Resources, which encourages greater focus on the aquatic invasive plant species. The DPI follows up on reports of invasive plant pests and cooperates with SCDNR if eradication or regulatory action is warranted. DPI conducts extensive survey for aquatic invasive plants such as *Salvinia molesta*. Recently DPI assisted SCDNR in the eradication of this invasive aquatic plant from SC. DPI's motto is "Regulation through

Education.” DPI is proactive in educating the public about invasive species before they are out of control.

The Cooperative Agricultural Pest Survey (CAPS) is a joint effort between states and USDA APHIS PPQ. The CAPS committee is made up of individuals from several agencies that act as an advisory group for activities to detect or delimit exotic pests in this state. Committee members provide input on upcoming exotic pest surveys, discuss survey results, and share relevant information on pest occurrences. Pest distribution data from surveys is submitted to a national database. CAPS surveys and other monitoring activities strive to protect agricultural and natural resources and prevent economic losses from exotic plants, pests and pathogens. The committee includes a diverse cross section of agencies that work closely with the public and concerned industries to prevent or slow the dispersal of invasive plants.

South Carolina Sea Grant Consortium (SCSGC) and Extension Program (SCSGEP)

The Consortium is a state agency charged with supporting research, education, training and technical assistance programs to enhance the practical use and conservation of coastal and marine resources and foster a sustainable economy and environment. The Consortium has eight member institutions: The Citadel, Clemson University, University of South Carolina, Coastal Carolina University, College of Charleston, Medical University of South Carolina, South Carolina Department of Natural Resources, and South Carolina State University. The agency's primary federal sponsor, the National Oceanic and Atmospheric Administration (NOAA) National Sea Grant College Program, supports aquatic nuisance species research, education and outreach activities around the country with emphasis on marine and Great Lakes environments. The staff includes six extension specialists who focus on aquaculture, fisheries, coastal hazards, coastal environmental quality, coastal communities and coastal processes. It has four communications staff in graphic design, technical writing, web design/management and public information. The extension program's aquaculture program helps develop an economically viable and natural resource-friendly aquaculture industry. South Carolina's aquaculture industry has grown dramatically in the last 10 years, and this agency has

played a leading role in support of that growth. It has also been involved in zebra mussel research and outreach awareness.

South Carolina Department of Health and Environmental Control

The South Carolina Department of Health and Environmental Control's Mosquito Control Disease Surveillance Program includes the following activities as an integral part of public health and a core function in environmental health. Investigations and monitoring of mosquito borne diseases are ongoing. The department conducts mosquito surveillance activities and promotes mosquito prevention activities for individuals and in the environment. Educational activities promoting the use of personal protective measures and prevention around homes are regularly emphasized. Technical training and technical consultations are provided to support the development and operation of local mosquito control programs. Local mosquito control programs are the responsibility of local governments. The department is however involved in disaster response actions when mosquitoes impede response and recovery actions.

The Shellfish Sanitation Section does not directly address invasive species in day-to-day management. SCDHEC's staff routinely discusses invasive species issues with DNR managers and researchers during quarterly meetings of the DHEC/DNR Shellfish Restoration Committee. Most regional Shellfish Section staff have attended DNR presentations regarding invasive species. Inquiries regarding importation of marine organisms are often received by staff that forward the inquiry to DNR and inform the caller of the likelihood of a DNR requirement for testing. Additionally, the Shellfish Sanitation Section has been involved in the issuance of joint DHEC/DNR relay permits that involve the export of shellfish to Virginia. Virginia requires that shellfish samples be sent to them so they may test for invasive species prior to project approval.

Federal Entities

U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (USDA APHIS PPQ)

APHIS safeguards agriculture and natural resources from the risks associated with the entry, establishment, or spread of animal and plant pests and noxious weeds. The Plant Protection Act (PPA, 7 U.S.C. 7701 et seq.), enforced by APHIS-PPQ, prohibits the introduction into, or the dissemination of a plant pest or noxious weed within the United States. South Carolina has five regional APHIS-PPQ field offices plus the state office, all of which work to exclude, detect and eradicate newly introduced plant pests or noxious weeds that pose risk to U.S. agriculture or the environment. APHIS-PPQ and the Department of Plant Industry, Clemson University work cooperatively in this safeguarding effort.

APHIS funding assists with aquatic nuisance species surveys in South Carolina. APHIS-PPQ's Smuggling, Interdiction and Trade Compliance (SITC) Program seeks to prevent unlawful entry and distribution of prohibited products that may harbor exotic plant and animal pests, diseases, or invasive species. SITC provides information about illegal imports obtained from various data sources for incoming cargo, which also helps target surveys.

U.S. Department of Agriculture, Forest Service

The USDA Forest Service has the goal nationally, regionally, and locally to reduce, minimize, or eliminate the potential for introduction, establishment, spread, and impact of non-native invasive species across all landscapes and ownerships. Emphasis areas include early detection and rapid response, control and management, rehabilitation and restoration, partnerships and collaboration, research, and information and education. The USDA - Forest Services maintains lists of both terrestrial and aquatic species, which are thought to be invasive (cause economic or ecological damage) on National Forest lands.

U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS)

NRCS provides technical and financial assistance to conserve South Carolina's natural

resources. NRCS works in close partnership with the South Carolina Association of Conservation Districts and has field staff available to assist private landowners in every county in South Carolina. NRCS administers several Farm Bill Conservation programs that provide cost share conservation assistance to agricultural producers to address resource concerns such as soil quality, soil erosion, water quality and wildlife habitat on agricultural lands. Private landowners also have the opportunity to enroll land in conservation programs that encourages the enhancement of wildlife habitat. Conservation easements, through the Wetland Reserve Program, to restore and enhance the functions and values of degraded wetlands in South Carolina, are also a high priority to NRCS. Wetland functions include surface water storage, ground water recharge, nutrient cycling, and protection of characteristic plant communities and wildlife habitat. The NRCS in South Carolina is providing funding and assisting in the administration of a local cost-share program for the control of phragmites on private property in the Winyah Bay area. On the national level, NRCS manages the National Invasive Species Information Center (www.invasivespeciesinfo.gov), an important invasive species information web site, and sits on the National Invasive Species Council, the Invasive Species Advisory Committee, and Aquatic Nuisance Species Task Force.

U.S. Coast Guard (USCG), Ballast Water Management (BWM) Program

USCG is responsible for enforcing ballast water regulations. In recent years there has been increased international focus on ballast water management due to the ecological, economic, and potential health threats caused by the spread of ANS from ballast water. USCG is responding to these concerns through a comprehensive national BWM program. This program applies to all vessels equipped with ballast water tanks that operate in U.S. waters and are bound for ports or places in the U.S. Highlights of the program are: mandatory ballast water management practices for all vessels that operate in U.S. waters; additional practices for vessels entering U.S. waters after operating beyond the Exclusive Economic Zone, and reporting and recordkeeping of ballasting operations by all vessels.

U.S. Army Corps of Engineers (USACE), Charleston District

USACOE, Charleston District is responsible for dredging Charleston and Georgetown Harbors, the Atlantic Intracoastal Waterway within South Carolina, and several shallow-draft navigation channels for the commercial fishing and shrimping industries. These shallow-draft channels include: Jeremy Creek, Town Creek, Five Fathom Creek, and Clarks Creek in McClellanville; Little River; Murrells Inlet; and Folly River. Charleston District is also performs beach nourishment projects, aquatic ecosystem restoration projects, flood control projects, and stream bank erosion protection projects. Charleston District does not manage any USACOE reservoirs.

The Charleston District's involvement in aquatic invasive species management is limited. Through the USACOE Aquatic Plant Control Program, Charleston District works closely with SCDNR to provide cost-share funding (when funding is allocated in the Federal budget) for aquatic plant control efforts in the state. This funding can only be used on public waters with public access, so the District's involvement is limited to public water bodies. The Charleston District is also working with the S.C. Department of Natural Resources to control the spread of the aquatic weed phragmites on dredge spoil areas in the state. They assist by providing the Department with the location of dredge spoil sites for survey purposes and plan to start reimbursing the Department for control expenditures on those sites. In addition, the Charleston District, through its Regulatory Program, issues permits pursuant to the Clean Water Act and the Rivers and Harbors Act. Charleston District issues permits for many activities in wetlands and bodies of water including: aquaculture activities, boat ramp construction, private dredging, and marinas. Many of these permits include special conditions to maintain water quality and prevent the spread of aquatic invasive species.

U.S. Army Corps of Engineers, Savannah District

USACOE, Savannah District (located in Georgia) is responsible for maintaining Savannah and Brunswick Harbors, the Intracoastal Waterway along Georgia's coastline and the Savannah River. The Savannah Harbor is a major foreign-trade and general cargo port that has great economic and strategic importance. Savannah District also is a leading producer of hydroelectric power, operating three major multi-purpose dam and

lake facilities along the Upper Savannah River along the Georgia/South Carolina border: J. Strom Thurmond, Richard B. Russell and Hartwell. Hydrilla was first discovered in J. Strom Thurmond Lake in 1995. The Savannah District prepared an Aquatic Plant Management Plan in 1998 in response to the presence of hydrilla in Thurmond Lake as well as other aquatic plants of concern in Hartwell Lake, Richard B. Russell Lake, and the New Savannah Bluff Lock and Dam. The plan establishes treatment priorities based on impacts to authorized project purposes, funding, treatments by others and environmental impacts. The Savannah District anticipates the spreading of aquatic invasive species. The Corps of Engineers has matching aquatic plant control program funds for the state of Georgia to treat nonfederal bodies of water in Georgia. However, these funds cannot be used to treat Thurmond Lake, because it is a federal water body.

The Savannah District interacts with the public through numerous boating facilities at all three reservoirs, and through public visitors at District offices. The district also educates and informs marina employees, boaters and general public about problems associated with improper sewage disposal and encourages the use of pump out stations. It uses displays, publications, workshops, promotional items, education programs and websites to reach target audiences. It helps coordinate the Clean Vessel/Clean Marina Program. The target audience and methods of reaching audiences are similar to aquatic invasive species issues.

U.S. Department of the Interior, National Park Service

The National Park Service (NPS) manages more than 32,000 acres of public land in South Carolina. This acreage is divided into four distinct management units including Congaree National Park (26,434 acres), Cowpens National Battlefield (1,833 acres), Fort Sumter National Monument (226 acres), and Kings Mountain National Military Park (3,945 acres). The National Park Service preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world. Congaree National Park is by far the largest NPS

site in South Carolina and was established to protect the largest remaining tract of old-growth bottomland hardwood forests in the southeastern U.S.

Exotic, non-native species are a primary management concern at all NPS sites containing significant land resources. In addition to Executive Order # 13112, there are specific NPS management policies directed at the removal of all exotic species. Significant efforts have been made in recent years to conduct baseline biological inventories at all park sites through a centralized inventory and monitoring program. Formal inventories of vascular plants, reptiles, amphibians, fish and small mammals have been completed at Congaree. More than 28 non-native plant species have been confirmed at the park including several aquatic nuisance species. Congaree also hosts the Southeast Coast Exotic Plant Management Team and is in the process of completing a draft exotic plant management plan.

U.S. Department of the Interior, Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS) has historically been the federal agency most involved with invasive species. The Lacey Act, which was originally passed in 1900, restricts importation, acquisition, and possession of wildlife deemed injurious. These non-native wildlife are considered injurious if their importation could impact negatively on agriculture, horticulture, forestry, the health and welfare of humans, and the welfare and survival of wildlife and wildlife resources in the United States. The National Invasive Species Act (NISA) was passed in 1996 amending the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. The 1990 Act established the Aquatic Nuisance Species (ANS) Task Force to direct ANS activities annually. The Task Force is co-chaired by the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration. In 1999, the Executive Order on Invasive Species established Invasive Species Council, which oversees activities of existing organizations that address invasive species. The USFWS supports the implementation of these Acts and the Executive Order through its Invasive Species Program. The priorities of the Program are as follows:

1. Increase public awareness of invasive species issues through education and outreach programs.
2. Coordinate aquatic nuisance species (ANS) management activities with other Federal and State agencies and private entities.
3. Provide technical assistance for controlling ANS on Federal lands.
4. Coordinate and conduct research activities.
5. Through the regulatory process, prevent the importation of nonindigenous nuisance species.

In South Carolina, USFWS has been active in managing aquatic invasive species at the Savannah National Wildlife Refuge, Cape Romain National Wildlife Refuge, ACE Basin National Wildlife Refuge and the Waccamaw National Wildlife Refuge using chemical control, water level management and prescribed fire. The USFWS administers grants through various programs that can be used for invasive species management and is a partner in the Winyah Bay Invasive Species Cost-share Program that provides matching funds to assist private property owners to control invasive species.

Electric Power and Water Utilities

Several public and private entities are dependent upon public waters for electric power production and some as a source of municipal water. All have a stake in the prevention and control of aquatic invasive species problems in South Carolina and all have some level of management responsibility based on their operating licenses from the Federal Energy Regulatory Commission. The U.S. Army Corps of Engineers manages three lakes on the Savannah River for power production: J. Strom Thurmond Lake, Richard B. Russell Lake, and Hartwell Lake. The operation of these lakes does not fall under FERC jurisdiction but the Corps of Engineers, as discussed above, has initiated invasive species management plans and operations on these lakes. The principal electric utilities and respective reservoirs in South Carolina are:

- Santee Cooper: Lakes Marion and Moultrie
- South Carolina Electric and Gas: Lakes Murray and Monticello
- Duke Energy: Lakes Cedar Creek (Stumpy Pond), Fishing Creek, Gaston Shoals, Great Falls, Jocassee, Keowee, Ninety-nine Islands, Wateree, Wylie

Santee Cooper - need information

South Carolina Electric and Gas – need information

Duke Energy

Direct impacts to power production operations by aquatic invasive species have been limited to the Asiatic clam, *Corbicula fluminea*. Power plant activities in response to *Corbicula* infestations include increased field sampling and reporting of clam population dynamics and increased in-plant maintenance of fire protection and heat exchange systems.

Invasive aquatic plants such as hydrilla (*Hydrilla verticillata*), parrotfeather (*Myriophyllum brasiliense*), brittle naiad (*Najas minor*), and creeping yellow water primrose (*Ludwigia hexapetala* ((*L. uruguayensis*)) have continued to move into mid-Atlantic Piedmont reservoirs during the last two decades. Some 1500 acres of hydrilla in Catawba-Wateree reservoirs beginning in 1994 have been managed using a combination of water level manipulation, herbicides and sterile Asian grass carp.

It is estimated that the 11 reservoirs that comprise the upper reaches of the Catawba-Wateree river basin have 21,000 acres of potential hydrilla habitat that, if left unmanaged, would impact all multiple use recreational reservoir activities enjoyed by the regional citizenry. In addition, 18 major power production facilities, more than 30 municipal drinking water intake and treatment systems supplying more than 1.5 million residential customers in the Charlotte – Rock Hill metropolitan area alone are in direct jeopardy.

Since 1994, it is estimated that \$250,000 has been expended to manage the invasive aquatic plant species listed above by Duke Energy. In addition, approximately \$160,000 has been invested in invasive aquatic plant research. It is anticipated that invasive aquatic plants will continue to spread in the Piedmont of the Carolinas. An example of this spread is the recent discovery of approximately eight acres of hydrilla growing around a public boat access ramp in Progress Energy's Lake Tillery located in the Pee Dee River basin of North Carolina.

Table 2. Agency responsibilities by pathway.

	Stocking	Aqua/Pet Rel	Shipping Bait Rel	Hitch Hikers	Aquascap	Aquaculture
SC Dept of Natural Resources	Yes			Yes	Yes	Yes
Aquatic Plant Management Council						
SC Department of Agriculture		Yes		Yes	Yes	
SC Dept of Health and Env Control		Yes		Yes	Yes	
SC SeaGrant Consortium						Yes
USDA - APHIS PPQ		Yes	Yes		Yes	
USDA - Forest Service						
USDA - Natural Res Cons. Service						
US Coast Guard			Yes			
USACE - Charleston District						
USACE - Savannah District						
USDI - National Park Service						
USDI - US Fish & Wildlife Service				Yes		

Management Goal and Objectives

Goal:

Prevent and control the introduction, spread and impact of aquatic invasive species in South Carolina.

Objectives:

1. Increase the coordination of AIS management and communication activities.
2. Educate the public on AIS, their impacts, and how they can help.
3. Monitor occurrence and spread of AIS
4. Eradicate established invasive species
5. Manage invasive species when eradication is impossible.
6. Identify research priorities on impacts and control of AIS.
7. Strengthen legislative and regulatory authority
8. Secure long-term funding for AIS activities

Proposed Management Actions and Legislative Initiatives

Implementation Table

Monitoring and Evaluation

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Appendices

APPENDIX A. MEMBERS OF THE SOUTH CAROLINA AQUATIC INVASIVE SPECIES TASK FORCE

Tom Abrahamsen	US Geological Survey - SC Water Science Center
Wayne Boykin	Congaree National Park
Stephen Compton	Clemson University Department of Plant Industry
Jason Crichton	South Carolina Aquarium
Steve deKozlowski	SC Department of Natural Resources
Rick DeVoe	SC Sea Grant Consortium
Ed DieBold	Riverbanks Zoo and Garden
Jeannie Eidson	SC Dept of Health and Environmental. Control
Ed EuDaly	US Fish and Wildlife Service
Larry Feller	SC Landscape and Turf Grass Association
Donna Foster	SC Nurseryman's Association
Ken Glenn	US Department of Agriculture - APHIS-PPQ
John Hensel	SCDHEC-Office of Coastal Resource Management
Bill Hulslander	Congaree National Park
Stan Hutto	SC Department of Parks, Recreation, and Tourism
John Inabinet	Santee Cooper
Darryl Jones	SC Forestry Commission
David Knott	SCDNR - Marine Resources Research Institute
Cam Lay	Clemson University Dept. of Pesticide Regulation
Billy Lempesis	SC State Ports Authority
Robin Mackie	US Forest Service - Francis Marion and Sumter National Forest
Ken Manuel	Duke Energy- Lake Services Environmental Center
Keith Nell	SC State Ports Authority
Matt Nespeca	The Nature Conservancy
Marilyn O'Leary	Southeast Aquatic Resources Partnership
Chris Page	SC Department of Natural Resources
Jennifer Rawlings	Riverbanks Zoo and Garden
Alan Shirey	US Army Corps of Engineers, Charleston District
Brandon Stutts	South Carolina Electric and Gas Company
Kelly Jo Swygert	SC Department of Transportation
Chris Thomason	SC Department of Natural Resources
David Tompkins	SC Department of Agriculture
Angela Viney	SC Wildlife Federation
Jack Whetstone	SC Sea Grant Consortium/Clemson University Ext.
Susan Wilde	USC / SCDNR Marine Resources
David Wilkins	South Carolina Aquarium
Dick Yetter	USDA- Natural Resources Conservation Service

APPENDIX B. STATE PROHIBITED SPECIES

Aquatic and Wetland Plants on the South Carolina Noxious Weed List

No person may possess, sell, offer for sale, import, bring or cause to be brought or imported into this State or release into the waters of this State the following plants:

<u>African oxygen weed *</u>	<u><i>Lagarosiphon major</i></u>
<u>Alligatorweed</u>	<u><i>Alternanthera philoxeroides</i></u>
<u>Ambulia *</u>	<u><i>Limnophila sessiliflora</i></u>
<u>Arrowhead *</u>	<u><i>Sagittaria sagittifolia</i></u>
<u>Arrow-leaved monochoria *</u>	<u><i>Monochoria hastata</i></u>
<u>Brazilian elodea</u>	<u><i>Egeria densa</i></u>
<u>Caulerpa *</u>	<u><i>Caulerpa taxifolia</i></u>
<u>Common reed</u>	<u><i>Phragmites australis</i></u>
<u>Duck-lettuce *</u>	<u><i>Ottelia alismoides</i></u>
<u>Eurasian watermilfoil</u>	<u><i>Myriophyllum spicatum</i></u>
<u>Exotic bur reed *</u>	<u><i>Sparganium erectum</i></u>
<u>Giant salvinia *</u>	<u><i>Salvinia molesta</i> <i>S. biloba</i>, <i>S. herzogii</i>, <i>S. auriculata</i></u>
<u>Hydrilla*</u>	<u><i>Hydrilla verticillata</i></u>
<u>Melaleuca *</u>	<u><i>Melaleuca quinquenervia</i></u>
<u>Miramar weed *</u>	<u><i>Hygrophila polysperma</i></u>
<u>Monochoria *</u>	<u><i>Monochoria vaginalis</i></u>
<u>Mosquito fern *</u>	<u><i>Azolla pinnata</i></u>
<u>Purple loosestrife</u>	<u><i>Lythrum salicaria</i></u>
<u>Rooted water hyacinth *</u>	<u><i>Eichhornia azurea</i></u>
<u>Slender naiad</u>	<u><i>Najas minor</i></u>
<u>Water chestnut</u>	<u><i>Trapa natans</i></u>
<u>Water hyacinth</u>	<u><i>Eichhornia crassipes</i></u>
<u>Water lettuce</u>	<u><i>Pistia stratiotes</i></u>
<u>Water primrose</u>	<u><i>Ludwigia hexapetala</i></u>
<u>Water spinach *</u>	<u><i>Ipomoea aquatica</i></u>
<u>Wetland nightshade *</u>	<u><i>Solanum tampicense</i></u>

* Also listed on Federal Noxious Weed list

South Carolina Prohibited Fish

No person may possess, sell, offer for sale, import, bring or cause to be brought or imported into this State or release into the waters of this State the following fish:

Carnero or candiru catfish	<i>Vandellia cirrhosa</i>
Freshwater electric eel	<i>Electrophorus electricus</i>
White amur or grass carp	<i>Ctenopharyngodon idella</i>
Walking catfish or a member of the clariidae family	Clarias, Heteropneustea, Gymnallabes, Channallabes, or Heterobranchus genera
Piranha	All members of Serrasalmus, Rooseveltiella, and Pygocentrus genera
Stickleback	
Mexican banded tetra	
Sea lamprey	
Rudd	<i>Scardinius erythrophthalmu-Linneaus</i>
Red-bellied pacu	<i>Piaractus brachypomus</i>
Lionfish	<i>Pterois volitans</i>

APPENDIX C. FEDERAL PROHIBITED SPECIES

Aquatic and Wetland Plants on the Federal Noxious Weed List (as of June 30, 2006)

No person may possess, sell, offer for sale, import, bring or cause to be brought or imported into the United States the following plants:

Mosquito fern	<i>Azolla pinnata</i> R. Brown
Killer algae	<i>Caulerpa taxifolia</i> (Vahl) C. Agardh, Mediterranean strain
Rooted waterhyacinth	<i>Eichornia azurea</i> (Swartz) Kunth
Hydrilla	<i>Hydrilla verticillata</i> (Linnaeus f.) Royle
Miramar weed	<i>Hygrophila polysperma</i> T. Anderson
Water-spinach	<i>Ipomoea aquatica</i> Forsskal
Moss	<i>Lagarosiphon major</i> (Ridley)
Ambulia	<i>Limnophila sessiliflora</i> (Vahl) Blume
Broadleaf paper bark tree	<i>Melaleuca quinquenervia</i> (Cav.) Blake <i>Monochoria hastata</i> (Linnaeus) Solms- Laubach <i>Monochoria vaginalis</i> (Burman f.) C. Presl <i>Ottelia alismoides</i> (L.) Pers.
Arrowhead	<i>Sagittaria sagittifolia</i> Linnaeus
Giant salvinia	<i>Salvinia auriculata</i> Aublet, <i>Salvinia</i> <i>biloba</i> Raddi, <i>Salvinia herzogii</i> de la Sota, <i>Salvinia molesta</i> D.S. Mitchell
Wetland nightshade	<i>Solanum tampicense</i> Dunal
Exotic bur-reed	<i>Sparganium erectum</i> Linnaeus

Federal Prohibited Fish, Mollusks, and Crustaceans

Importation of live or dead fish, mollusks, and crustaceans, or their eggs. No person may possess, sell, offer for sale, import, bring or cause to be brought or imported into the United States the following species:

Live fish or viable eggs of walking catfish of the Family Clariidae

Live mitten crabs or their viable eggs of the genus *Eriocheir*

Live mollusks, veligers, or viable eggs of zebra mussels of the
genus *Dreissena*

Any live fish or viable eggs of snakehead fishes of the genera
Channa and *Parachanna* (or their generic synonyms of
Bostrychoides, *Ophicephalus*, *Ophiocephalus*, and
Paraphiocephalus) of the Family Channidae, including but not
limited to:

(A) *Channa amphibeus* (Chel or Borna snakehead).

(B) *Channa argus* (Northern or Amur snakehead).

- (C) *Channa asiatica* (Chinese or Northern Green snakehead).
- (D) *Channa aurantimaculata*.
- (E) *Channa bankanensis* (Bangka snakehead).
- (F) *Channa baramensis* (Baram snakehead).
- (G) *Channa barca* (barca or tiger snakehead).
- (H) *Channa bleheri* (rainbow or jewel snakehead).
- (I) *Channa cyanospilos* (bluespotted snakehead).
- (J) *Channa gachua* (dwarf, gaucha, or frog snakehead).
- (K) *Channa harcourtbutleri* (Inle snakehead).
- (L) *Channa lucius* (shiny or splendid snakehead).
- (M) *Channa maculata* (blotched snakehead).
- (N) *Channa marulius* (bullseye, murrel, Indian, great, or cobra snakehead).
- (O) *Channa maruloides* (emperor snakehead).
- (P) *Channa melanoptera*.
- (Q) *Channa melasoma* (black snakehead).
- (R) *Channa micropeltes* (giant, red, or redline snakehead).
- (S) *Channa nox*.
- (T) *Channa orientalis* (Ceylon or Ceylonese Green snakehead).
- (U) *Channa panaw*.
- (V) *Channa pleurophthalmus* (ocellated, spotted, or eyespot snakehead).
- (W) *Channa punctata* (dotted or spotted snakehead).
- (X) *Channa stewartii* (golden snakehead).
- (Y) *Channa striata* (chevron or striped snakehead).
- (Z) *Parachanna africana* (Niger or African snakehead).
- (AA) *Parachanna insignis* (Congo, square-spotted African or light African snakehead).
- (BB) *Parachanna obscura* (dark African, dusky, or square-spotted snakehead).

APPENDIX D. NON-INDIGENOUS SPECIES IN SOUTH CAROLINA

USGS-NAS - Nonindigenous Aquatic Species List

Scientific Name	Common Name	Native Habitat	Exotic / Native Transplant
Coelenterates-Hydrozoans			
<i>Craspedacusta sowerbyi</i>	freshwater jellyfish	Freshwater	Exotic
<i>Maeotias inexpectata</i>	Black Sea jellyfish	Freshwater-Marine	Exotic
Coelenterates-Scyphozoan			
<i>Drymonema dalmatinum</i>	pink meanie	Freshwater	Exotic
Crustaceans-Barnacles			
<i>Balanus amphitrite</i>	striped barnacle, purple acorn barnacle	Marine	Exotic
<i>Megabalanus coccopoma</i>	Titan acorn barnacle	Brackish-Marine	Exotic
Crustaceans-Cladocerans			
<i>Daphnia lumholtzi</i>	water flea	Freshwater	Exotic
Crustaceans-Copepods			
<i>Eurytemora affinis</i>	calanoid copepod	Freshwater-Marine	Native Transplant
Crustaceans-Crabs			
<i>Callinectes bocourti</i>	Bocourt swimming Crab, red blue crab	Marine	Exotic
<i>Charybdis hellerii</i>	an Indo-Pacific crab	Marine	Exotic
<i>Petrolisthes armatus</i>	green porcelain crab	Marine	Native Transplant
Crustaceans-Crayfish			
<i>Cambarus longirostris</i>	crayfish	Freshwater	Native Transplant
<i>Procambarus clarkii</i>	red swamp crayfish	Freshwater	Native Transplant
Crustaceans-Isopods			
<i>Ligia exotica</i>	wharf roach	Marine	Exotic
<i>Synidotea laevidorsalis</i>	an isopod	Marine	Exotic
Crustaceans-Shrimp			
<i>Litopenaeus vannamei</i>	Pacific white shrimp	Marine	Exotic
<i>Penaeus monodon</i>	Asian tiger shrimp	Marine	Exotic
<i>Penaeus stylirostris</i>	blue shrimp	Marine	Exotic
Fishes			
<i>Ambloplites rupestris</i>	rock bass	Freshwater	Native Transplant
<i>Astronotus ocellatus</i>	oscar	Freshwater	Exotic
<i>Carassius auratus</i>	goldfish	Freshwater	Exotic
<i>Carpionodes velifer</i>	highfin carpsucker	Freshwater	Native Transplant
<i>Colossoma macropomum</i>	tambaqui	Freshwater	Exotic
<i>Colossoma or Piaractus sp.</i>	unidentified pacu	Freshwater	Exotic
<i>Ctenopharyngodon idella</i>	grass carp	Freshwater	Exotic
<i>Cyprinella pyrrhomelas</i>	fieryblack shiner	Freshwater	Native Transplant
<i>Cyprinus carpio</i>	common carp	Freshwater	Exotic
<i>Dorosoma petenense</i>	threadfin shad	Freshwater-Marine	Native Transplant

<i>Esox masquinongy</i>	muskellunge	Freshwater	Native Transplant
<i>Etheostoma zonale</i>	banded darter	Freshwater	Native Transplant
<i>Ictalurus furcatus</i>	blue catfish	Freshwater	Native Transplant
<i>Ictalurus punctatus</i>	channel catfish, graceful catfish	Freshwater	Native Transplant
<i>Ictiobus bubalus</i>	smallmouth buffalo	Freshwater	Native Transplant
<i>Jordanella floridae</i>	flagfish	Freshwater	Native Transplant
<i>Lepomis cyanellus</i>	green sunfish	Freshwater	Native Transplant
<i>Lepomis macrochirus</i>	bluegill	Freshwater	Native Transplant
<i>Lepomis microlophus</i>	redeer sunfish	Freshwater	Native Transplant
<i>Lucania goodei</i>	bluefin killifish	Freshwater	Native Transplant
<i>Luxilus coccogenis</i>	warpaint shiner	Freshwater	Native Transplant
<i>Micropterus dolomieu</i>	smallmouth bass	Freshwater	Native Transplant
<i>Micropterus punctulatus</i>	spotted bass	Freshwater	Native Transplant
<i>Morone americana x saxatilis</i>	white perch x striped bass	Freshwater	Native Transplant
<i>Morone chrysops</i>	white bass	Freshwater-Marine	Native Transplant
<i>Morone chrysops x saxatilis</i>	wiper	Freshwater-Marine	Native Transplant
<i>Morone saxatilis</i>	striped bass	Freshwater-Marine	Native Transplant
<i>Nocomis micropogon</i>	river chub	Freshwater	Native Transplant
<i>Oncorhynchus mykiss</i>	rainbow trout	Freshwater-Marine	Native Transplant
<i>Perca flavescens</i>	yellow perch	Freshwater	Native Transplant
<i>Piaractus brachypomus</i>	pirapatinga, red-bellied pacu	Freshwater	Exotic
<i>Pomoxis annularis</i>	white crappie	Freshwater	Native Transplant
<i>Pterois volitans/miles</i>	lionfish	Marine	Exotic
<i>Pterygoplichthys pardalis</i>	sailfin catfish	Freshwater	Exotic
<i>Pylodictis olivaris</i>	flathead catfish	Freshwater	Native Transplant
<i>Salmo salar</i>	Atlantic salmon	Freshwater-Marine	Native Transplant
<i>Salmo trutta</i>	brown trout	Freshwater-Marine	Exotic
<i>Salvelinus fontinalis</i>	brook trout	Freshwater	Native Transplant
<i>Sander canadense</i>	sauger	Freshwater	Native Transplant

<i>Sander vitreus</i>	walleye	Freshwater	Native Transplant
<i>Tilapia zillii</i>	redbelly tilapia	Freshwater	Exotic
<i>Tinca tinca</i>	tench	Freshwater	Exotic
Mollusks-Bivalves			
<i>Corbicula fluminea</i>	Asian clam	Freshwater	Exotic
<i>Perna viridis</i>	green mussel	Marine	Exotic
Mollusks-Gastropods			
<i>Cipangopaludina chinensis malleata</i>	Chinese mysterysnail	Freshwater	Exotic
Plants			
<i>Alternanthera philoxeroides</i>	alligatorweed	Freshwater	Exotic
<i>Colocasia esculenta</i>	wild taro	Freshwater	Exotic
<i>Egeria densa</i>	Brazilian waterweed	Freshwater	Exotic
<i>Eichhornia crassipes</i>	water-hyacinth	Freshwater	Exotic
<i>Hydrilla verticillata</i>	hydrilla	Freshwater	Exotic
<i>Landoltia (Spirodela) punctata</i>	dotted duckweed	Freshwater	Exotic
<i>Ludwigia hexapetala</i>	Uruguay seedbox	Freshwater	Exotic
<i>Murdannia keisak</i>	marsh dewflower	Freshwater	Exotic
<i>Myriophyllum aquaticum</i>	parrot-feather	Freshwater	Exotic
<i>Myriophyllum spicatum</i>	Eurasian water-milfoil	Freshwater	Exotic
<i>Najas minor</i>	brittle naiad	Freshwater	Exotic
<i>Nasturtium officinale</i>	water-cress	Freshwater	Exotic
<i>Nelumbo nucifera</i>	sacred lotus	Freshwater	Exotic
<i>Nymphaea mexicana</i>	banana water-lily	Freshwater	Native Transplant
<i>Oryza sativa</i>	rice	Freshwater	Exotic
<i>Panicum repens</i>	torpedo grass	Freshwater	Exotic
<i>Pistia stratiotes</i>	water-lettuce	Freshwater	Exotic
<i>Potamogeton crispus</i>	curly pondweed	Freshwater	Exotic
<i>Sagittaria montevidensis</i>	long-lobed arrow-head	Freshwater	Exotic
<i>Salvinia minima</i>	water spangles	Freshwater	Exotic
<i>Salvinia molesta</i>	giant salvinia	Freshwater	Exotic
<i>Urochloa (Brachiaria) mutica</i>	para grass	Freshwater	Exotic
Reptiles-Turtles			
<i>Chrysemys picta</i>	Painted Turtle	Freshwater	Native Transplant
<i>Trachemys scripta elegans</i>	Red-eared Slider	Freshwater	Native Transplant

David Knott's list ?????

Cnidarians

hydrozoan	<i>Blackfordia virginica</i>
hydrozoan	<i>Cordylophora caspia</i>
hydrozoan	<i>Maeotias marginata</i>
hydrozoan	<i>Moerisia lyonsi</i>
hydrozoan	<i>Garvia franciscana</i>
jellyfish	<i>Drymonema dalmatinum</i>

anemone	<i>Nematostella vectensis</i>
anemone	<i>Haliplanella lineate</i>

Annelids

polychaete	<i>Fabricia sabella</i>
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Mollusks

pulmonate snail	<i>Microtralia ovula</i>
pulmonate snail	<i>Creedonia succinea</i>
pulmonate snail	<i>Myosotella myosotis</i>
Japanese mysterysnail	<i>Bellamya japonica</i>
Banded mysterysnail	<i>Viviparus georgianus</i>
Olive mysterysnail	<i>Viviparus subpurpurea</i>
Asian clam	<i>Corbicula fluminea</i>
Atlantic rangia	<i>Rangia cuneata</i>
Asian green mussel	<i>Perna viridis</i>

Crustaceans

cladoceran	<i>Daphnia lumhotzi</i>
barnacle	<i>Balanus Amphitrite</i>
barnacle	<i>Balanus trigonus</i>
barnacle	<i>Megabalanus coccopoma</i>
parasitic barnacle	<i>Loxothylacus panopaei</i>
copepod	<i>Eurytemora affinis</i>
copepod	<i>Skistodiaptomus pallidus</i>
copepod	<i>Elaphiodella bidens bidens</i>
tanaid	<i>Sinelobus stanfordi</i>
isopod	<i>Ligia exotica</i>
isopod	<i>Synidotea laticauda</i> (<i>S. laevidorsalis</i> ?)
isopod	<i>Paradella dianae</i>
isopod	<i>Sphaeroma terebrans</i>
amphipod	<i>Stenothoe gallensis</i>
amphipod	<i>Caprella scaura</i>
crayfish	<i>Cambarus longirostris</i>
Red swamp crayfish	<i>Procambarus clarkii</i>
Asian tiger shrimp	<i>Penaeus monodon</i>
Blue shrimp	<i>Litopenaeus stylirostris</i>
Pacific white shrimp	<i>Litopenaeus vannamei</i>
Bristled river shrimp	<i>Macrobrachium olfersii</i>
Green porcelain crab	<i>Petrolisthes armatus</i>
Bocourt swimming crab	<i>Callinectes bocourti</i>
rugose swimming crab	<i>Callinectes exasperatus</i>

spiny hands crab
blue landcrab

Charybdis hellerii
Cardisoma guanhumi

Ascidians

rough sea squirt
Lister's encrusting tunicate
sea grapes

Styela canopus (= *S. partita*)
Diplosoma listerianum
Molgula manhattensis

Insects

mosquito
mosquito

Aedes albopictus
Ochlerotatus japonicus

Mammals

Nutria

Myocastor coypus

APPENDIX E. SUMMARY OF SOUTH CAROLINA STATE LAWS, PROGRAMS, AND REGULATIONS RELEVANT TO AQUATIC INVASIVE SPECIES

TITLE 46 - AGRICULTURE

Chapter 9 – STATE CROP PEST COMMISSION

SECTION 46-9-40. Authority to promulgate and enforce regulations; other powers of commission.

The commission, in accordance with the Administrative Procedures Act, may promulgate and enforce reasonable regulations as in the judgment of the commission may be necessary to eradicate or prevent the introduction, spread, or dissemination of plant pests, including genetically engineered plants or plant pest organisms, and prevent fraud or misrepresentation in the sale and dissemination of fruit trees, nut trees, shade and ornamental trees, vines, shrubs, plants, bulbs, and roots for propagation purposes. The commission may regulate or prohibit the shipment within, or the importation into, this State of plants, farm products, or other articles of any nature or character from a state, territory, or foreign country when, in the opinion of the commission, the regulation or prohibition is necessary to prevent the introduction or dissemination of plant pests.

The commission may carry out operations, including quarantines or measures to locate, suppress, control, or eradicate or to prevent or retard the spread of plant pests, independently or in cooperation with counties or their political subdivisions, municipalities, farmers' associations or similar organizations, individuals, federal agencies, or agencies of other states, by regulation, compliance agreement, judicial action, or other appropriate means.

Chapter 23 – NOXIOUS WEEDS

SECTION 46-23-10. Short title.

This chapter may be cited as the "**South Carolina Noxious Weed Act.**"

SECTION 46-23-20. Definitions.

As used in this chapter:

(a) "Commissioner" means the Commissioner of Agriculture of South Carolina or any other person to whom authority may be delegated to act in his stead.

(b) "Authorized inspector" means an employee of South Carolina Department of Agriculture or an employee of a cooperating agency specifically authorized to enforce the provisions of the Federal Noxious Weed Act.

(c) "Noxious weed" means any living stage of any plant including seed or reproductive parts thereof or parasitic plants or parts thereof which is determined by the Commissioner of Agriculture to be directly or indirectly injurious to public health, crops, livestock, or agriculture including but not limited to waterways and irrigation canals.

(d) "Move" means to ship, offer for shipment, offer for entry, import, receive for transportation or transport by a common carrier or carry, transport, move or allow to be moved by any means.

SECTION 46-23-30. Commissioner may prevent introduction and dissemination of noxious weeds in State; remedies of owner of property destroyed or disposed of.

(a) The Commissioner may, when he deems it necessary as an emergency measure in order to prevent the introduction into or the dissemination within South Carolina of any noxious weed new to or not theretofore widely prevalent or distributed within and throughout the State, seize, quarantine, treat, destroy, apply other remedial measures to, export, return to shipping point, or otherwise dispose of in such a manner as he deems appropriate, any noxious weed or any product or article of any character whatsoever or any means of conveyance which he has reason to believe contains or is contaminated with any noxious weed, offered for movement, moving, or has moved into or through the State or intrastate. Provided, that no such noxious weed, product, article or means of conveyance shall be destroyed, exported, or returned to the shipping point or so ordered to be destroyed, exported, or returned to the shipping point, unless in the opinion of the Commissioner, there is no less drastic action which would be adequate to prevent the introduction or dissemination of noxious weeds.

(b) The Commissioner may order the owner or person in possession of any new or not theretofore widely prevalent noxious weed, or any product, article, or means of conveyance, or his agent to treat, apply other remedial measures to, destroy, export, return to shipping point, or make other disposition of such noxious weed, product, article, or means of conveyance without cost to the State or agency cooperating with the State in such a manner as the Commissioner deems appropriate. The Commissioner may apply to a court of competent jurisdiction in which such person resides or transacts business or in which the noxious weed, product, article, or means of conveyance is found for enforcement of such order by injunction, mandatory or otherwise. Process in any such case may be served in any judicial district wherein the defendant resides or transacts business or may be found, and subpoena for witnesses who are required to attend a court in any

judicial district in such a case shall have force and effect in any other judicial district.

(c) The owner of any noxious weed, product, article, or means of conveyance, destroyed or otherwise disposed of by the Commissioner under this section, may bring an action against the State within one year after such destruction or disposal, and recover just compensation for the destruction or disposal of such noxious weed, product, article, or means of conveyance (not including compensation for loss due to delays incident to determining eligibility for movement into or through South Carolina or for intrastate movement) if the owner establishes that such action was not warranted under this section. Any judgment rendered in favor of such owner shall be paid out of the money appropriated for noxious weed control.

(d) The Commissioner may promulgate such emergency regulations as he deems necessary to prevent the introduction into or the dissemination within the State of noxious weeds.

SECTION 46-23-40. Quarantines.

(a) The Commissioner is authorized and directed to quarantine any county, or any portion thereof, when he deems that such quarantine is necessary to prevent the spread of any noxious weed. Before such quarantine is established, the Commissioner shall give due notice of hearing under such regulations as he may prescribe. At such hearing, any interested party may appear and be heard, either in person or by attorney.

(b) The Commissioner is directed to give notice of quarantine or amendments thereto through publication in the county newspaper.

(c) No persons shall ship or offer for shipment to any common carrier, nor shall any common carrier receive for transportation or transport, nor shall any person carry or transport from any quarantined county or any quarantined portion thereof, into or through any other county, any noxious weed or any other product, article, or means of conveyance of any character whatsoever except as specified in the regulations issued by the Commissioner.

(d) The Commissioner shall make and promulgate rules and regulations governing the inspection, disinfection, certification, and methods and manner of movement of noxious weeds and any carriers thereof specified in the notice of the quarantine.

SECTION 46-23-50. Commissioner may detect and prevent spread of noxious weeds.

The Commissioner is authorized to carry out operations or measures necessary to detect, eradicate, suppress, control, or prevent the spread of noxious weeds new to

or not heretofore widely prevalent or distributed within and throughout the State. The Commissioner is authorized to promulgate rules and regulations to accomplish the purposes of this chapter.

SECTION 46-23-60. Inspections and seizures.

Any authorized inspector shall have authority to stop and inspect without a warrant any person or means of conveyance moving into the State and any noxious weed, and any product or article of any character whatsoever which he has reason to believe contains or is contaminated with any noxious weed, to determine whether such person, product, article, or means of conveyance contains or is carrying any noxious weed contrary to this chapter or the regulations promulgated thereunder, and whether any such noxious weed, product, article or means of conveyance contains or is contaminated with any noxious weed or is moving in violation of this chapter or any regulation promulgated thereunder; to stop and inspect, without a warrant, any person, product, article, or means of conveyance moving intrastate and any noxious weed, when he has reason to believe that such means of conveyance, product, or article contains any noxious weed, is contaminated thereby, or is moving contrary to the provisions of this chapter or any regulation promulgated thereunder; and to enter, with a warrant, any premises in the State to make any inspections and seizures necessary under this chapter. Any judge of a court of competent jurisdiction in South Carolina may, within his respective jurisdiction upon proper oath or affirmation showing probable cause to believe that there are on certain premises any noxious weeds, products, articles, or means of conveyance, regulated or subject to disposal under this chapter, issue warrants for the entry of such premises to make any inspections or seizures under this chapter. Such warrants may be executed by any authorized employee of the South Carolina Department of Agriculture.

SECTION 46-23-70. Cooperation with other governments and agencies.

The Commissioner is authorized to cooperate with the federal government, state agencies, farmers' organizations, other groups, and individuals in the conduction of those operations necessary to accomplish the purposes of this chapter. The Commissioner is further authorized to cooperate with the governments of other states in carrying out necessary surveys, control operations, or quarantine measures, deemed necessary to eradicate, suppress, control, or retard the spread of noxious weeds, whenever the Commissioner determines that such cooperation with the officials in other states is necessary or desirable to protect the interests of this State.

SECTION 46-23-80. Penalty.

Any person who violates any provision of this chapter, or any regulation promulgated thereunder, shall be deemed guilty of a misdemeanor and upon

conviction shall be punished by a fine not exceeding five hundred dollars, or by imprisonment not exceeding one year, or both.

TITLE 49 – WATERS, WATER RESOURCES AND DRAINAGE

Chapter 6 – AQUATIC PLANT MANAGEMENT

SECTION 49-6-10. Purpose; administering agency. There is hereby created the South Carolina Aquatic Plant Management Program for the purpose of preventing, identifying, investigating, managing, and monitoring aquatic plant problems in public waters of South Carolina. The program will coordinate the receipt and distribution of available federal, state, and local funds for aquatic plant management activities and research in public waters. The Department of Natural Resources (department) is designated as the state agency to administer the Aquatic Plant Management Program and to apply for and receive grants and loans from the federal government or such other public and private sources as may be available for the Aquatic Plant Management Program and to coordinate the expenditure of such funds.

SECTION 49-6-20. Aquatic Plant Management Trust Fund.

There is created the South Carolina Aquatic Plant Management Trust Fund which must be kept separate from other funds of the State. The fund must be administered by the department for the purpose of receiving and expending funds for the prevention, management, and research of aquatic plant problems in public waters of South Carolina. Unexpended balances, including interest derived from the fund, must be carried forward each year and used for the purposes specified above. The fund shall be subject to annual audit by the Office of the State Auditor. The fund is eligible to receive appropriations of state general funds, federal funds, local government funds, and funds from private entities including donations, grants, loans, gifts, bond issues, receipts, securities, and other monetary instruments of value. All reimbursements for monies expended from this fund must be deposited in this fund.

SECTION 49-6-30. Aquatic Plant Management Council; membership; duties.

There is hereby established the South Carolina Aquatic Plant Management Council, hereinafter referred to as the council, which shall be composed of ten members as follows: The council shall include one representative from each of the following agencies, to be appointed by the chief executive officer of each agency:

- Water Resources Division of the Department of Natural Resources;
- South Carolina Department of Health and Environmental Control;
- Wildlife and Freshwater Fish Division of the Department of Natural Resources;
- South Carolina Department of Agriculture;
- Coastal Division of the Department of Health and Environmental Control;

- South Carolina Public Service Authority;
- Land Resources and Conservation Districts Division of the Department of Natural Resources;
- South Carolina Department of Parks, Recreation and Tourism;
- Clemson University, Department of Fertilizer and Pesticide Control.
- The council shall include one representative from the Governor's Office, to be appointed by the Governor.

The representative of the Water Resources Division of the Department of Natural Resources shall serve as chairman of the council and shall be a voting member of the council. The council shall provide interagency coordination and serve as the principal advisory body to the department on all aspects of aquatic plant management and research. The council shall establish management policies, approve all management plans, and advise the department on research priorities.

SECTION 49-6-40. Aquatic Plant Management Plan.

The department, with advice and assistance from the council, shall develop an Aquatic Plant Management Plan for the State of South Carolina. The plan shall describe the procedures for problem site identification and analysis, selection of control methods, operational program development, and implementation of operational strategies. The plan shall also identify problem areas, prescribe management practices, and set management priorities. The plan shall be updated and amended at appropriate intervals as necessary; provided, however, problem site identification and allocation of funding shall be conducted annually. In addition, the department shall establish procedures for public input into the plan and its amendments and priorities. The public review procedures shall be an integral part of the plan development process. When deemed appropriate, the department may seek the advice and counsel of persons and organizations from the private, public, or academic sectors. The council shall review and approve all plans and amendments. Approval shall consist of a two-thirds vote of the members present. The department shall have final approval authority over those sections that do not receive two-thirds approval of the council.

TITLE 50 – FISH, GAME AND WATERCRAFT

Chapter 5 – SOUTH CAROLINA MARINE RESOURCES ACT OF 2000

SECTION 50-5-45. Maintenance and publication of nonindigenous organisms list; introduction of such organisms prohibited.

(A) The department shall maintain and publish a list of any species, varieties, or strains of nonindigenous organisms known or suspected to present an adverse impact to fish or marine resources of this State. The list shall include the common and scientific name and the actual or potential adverse impact of each organism.

(B) It is unlawful:

- (1) to place in the salt waters of this State, or in privately owned waters directly connected to salt waters of this State, any live, fresh, or frozen whole, part, or product of any listed organism; or
- (2) to sell or offer for sale as bait, any live, fresh, or frozen whole, part, or product of any listed organism.

Chapter 13 - PROTECTION OF FISH

SECTION 50-13-1415 -Importation, possession, or placing water hyacinth and hydrilla in waters of the state.

No person shall possess, sell, offer for sale, import, bring, or cause to be brought or imported into this State, or release or place into any waters of this State any of the following plants:

- (1) Water Hyacinth
- (2) Hydrilla

Provided, however, that the department may issue special import permits to qualified persons for research purposes only.

The department shall prescribe the methods, control, and restrictions which are to be adhered to by any person or his agent to whom a special permit under the provisions of this section is issued. The department is authorized to promulgate such regulations as may be necessary to effectuate the provisions of this section and the department, by regulation, is specifically authorized to prohibit additional species of plants from being imported, possessed, or sold in this State when, in the discretion of the department, such species of plants are potentially dangerous.

SECTION 50-13-1630. Importing, possessing or selling certain fish unlawful; special permits for research; Department shall issue rules and regulations.

No person may possess, sell, offer for sale, import, bring or cause to be brought or imported into this State or release into the waters of this State the following fish:

1. carnero or candiru catfish (*Vandellia cirrhosa*);
2. freshwater electric eel (*Electrophorus electricus*);
3. white amur or grass carp (*Ctenopharyngodon idella*);
4. walking catfish or a member of the Clariidae family (*Clarias*, *Heteropneustea*, *Gymnallabes*, *Channallabes*, or *Heterobranchus* genera);
5. piranha (all members of *Serrasalmus*, *Rooseveltiella*, and *Pygocentrus* genera);
6. stickleback;
7. Mexican banded tetra;
8. sea lamprey;
9. rudd (*Scardinius erythrophthalmus*-Linnaeus).

The department may issue special import permits to qualified persons for research and education only.

The department may issue special permits for the stocking of nonreproducing white amur or grass carp hybrids in the waters of this State.

It is unlawful to take grass carp from waters stocked as permitted by this section. Grass carp caught must be returned to the water from which it was taken immediately.

The department must prescribe the qualifications, methods, controls, and restrictions required of a person or his agent to whom a special permit is issued. The department must condition all permits issued under this section to safeguard public safety and welfare and prevent the introduction into the wild or release of nonnative species of fish or other organisms into the waters of this State. The department may promulgate regulations necessary to effectuate this section and specifically to prohibit additional species of fish from being imported, possessed, or sold in this State when the department determines the species of fish are potentially dangerous.

Chapter 16 - IMPORTATION OF WILDLIFE

SECTION 50-16-10. “Wildlife” defined.

For the purpose of this chapter, “wildlife” means a member of the animal kingdom including without limitation a mammal, fish, bird, amphibian, reptile, mollusk, crustacean, arthropod, or other invertebrate.

SECTION 50-16-20. Importation of wildlife for certain purposes prohibited; investigation; permit.

(A) It is unlawful for a person to import, possess, or transport for the purpose of release or to introduce or bring into this State any live wildlife of the following types without a permit from the department:

(1) a furbearer, a member of the family Cervidae, a nondomestic member of the families Suidae (pigs), Tayassuidae (peccaries), Bovidae (bison, mountain goat, mountain sheep), coyote, bear, or turkey (genus *Meleagris*). Furbearer includes, but is not limited to, red and gray fox, raccoon, opossum, muskrat, mink, skunk, otter, bobcat, weasel, and beaver;

(2) a species of marine or estuarine fish, crustacean, mollusk, or other marine invertebrate not already found in the wild, or not native to this State.

(3) a species of freshwater fish, crustacean, mollusk, or other freshwater invertebrate not already found in the wild or not native to this State.

(B) A permit may be granted only after the investigations and inspections of the wildlife have been made as the department considers necessary and the department approves the possession, transportation, or importation into the State. The department may not issue a permit unless it finds:

(1) the wildlife was taken lawfully in the jurisdiction in which it originated;

(2) the importation, release, or possession of the wildlife is not reasonably expected to adversely impact the natural resources of the State or its wildlife populations.

SECTION 50-16-30. Importation of diseased animals prohibited.

It is unlawful for a person to possess, transport, or otherwise bring into the State or release or introduce into the State any diseased wildlife or other animal that reasonably might be expected to pose a public health or safety hazard as determined by the South Carolina Department of Health and Environmental Control after consultation with the department.

SECTION 50-16-40. Exception to permit requirement for wildlife imported for exhibition to purposes.

Wildlife imported for exhibition purposes only by state wildlife departments, municipal zoos or parks, public museums, public zoological parks, and public scientific or educational institutions operated not for profit, and transient circuses are not required to procure a permit under Section 50-16-20. Nothing in this chapter prohibits the department or its duly authorized agents from possessing, importing, or releasing wildlife.

SECTION 50-16-50. Authority to promulgate regulations.

The department may promulgate regulations to effectuate the provisions of this chapter.

SECTION 50-16-60. Exception to permit requirement for certain wildlife imported for sale as pets.

The importation of the following wildlife for sale in the pet trade does not require a permit:

1. tropical fishes
2. rats and mice
3. rabbits
4. canaries
5. gerbils
6. shell parakeets
7. love birds
8. cockatiels
9. parrots
10. toucans
11. mynah birds
12. finches
13. hamsters
14. guinea pigs
15. reptiles
16. amphibians.

The provisions of this section do not privilege the import or possession of a species otherwise protected or regulated by other provisions of this title.

SECTION 50-16-70. Penalties.

A person violating the provisions of this chapter is guilty of a misdemeanor and, upon conviction, must be fined not more than one thousand dollars or imprisoned not more than six months, or both.

Chapter 18 –AQUACULTURE (Article 2. - THE AQUACULTURE ENABLING ACT)

SECTION 50-18-245. Requirements to engage in aquaculture of nonindigenous species.

To engage in the aquaculture of a nonindigenous species a person must first obtain:

- (1) a nonindigenous species permit as provided in this title, and
- (2) an aquaculture permit.

SECTION 50-18-270. Intentional release of imported species into public waterways; penalties.

(A) Except as provided in this subsection it is unlawful to place or release intentionally any species imported from another state or jurisdiction into public waters in this State without a permit issued by the department. This section does not apply to the use of live bait. The department may grant permits at no cost to allow permitted aquaculturists to release aquacultured products into the public waters of this State as a part of a stocking program conducted or approved by the department.

(B) A person who violates this section is guilty of a misdemeanor and, upon conviction, must be fined not less than one thousand dollars and not more than five thousand dollars or imprisoned for not more than thirty days. In addition to any penalty the presiding magistrate may order restitution to the department.

(C) A person who violates this section for a second or subsequent offense within three years of a first offense must be fined five thousand dollars, no part of which may be suspended, or imprisoned for up to one year, or both. In addition to any penalty the presiding judge may order restitution to the department.

APPENDIX F. SUMMARY OF FEDERAL LAWS, PROGRAMS, AND REGULATIONS RELEVANT TO AQUATIC INVASIVE SPECIES

The Plant Protection Act (PPA, 7 U.S.C. 7701 et seq.)

The Plant Protection Act authorizes the Secretary of Agriculture to prohibit or restrict the importation, entry, exportation, or movement in interstate commerce of any plant, plant product, biological control organism, noxious weed, article, or means of conveyance if the Secretary determines that the prohibition or restriction is necessary to prevent the introduction of a plant pest or noxious weed into the United States or the dissemination of a plant pest or noxious weed within the United States. The PPA defines “noxious weed” as “any plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry or other interests of agriculture, irrigation, navigation, the natural resources of the United States, the public health, or the environment.” The PPA also provides that the Secretary may publish, by regulation, a list of noxious weeds that are prohibited or restricted from entering the United States or that are subject to restrictions on interstate movement within the United States. Under this authority, the Animal and Plant Health Inspection Service (APHIS) administers the noxious weeds regulations in 7 CFR part 360, which prohibit or restrict the importation and interstate movement of those plants that are designated as noxious weeds in § 360.200.

Title 7, Chapter 61- Federal Noxious Weed Act of 1974

Federal Noxious Weed Act -- Public Law 93-629 (7 U.S.C. 2801 et seq.; 88 Stat. 2148), enacted January 3, 1975, established a Federal program to control the spread of noxious weeds. The Secretary of Agriculture was given the authority to designate plants as noxious weeds by regulation, and the movement of all such weeds in interstate or foreign commerce was prohibited except under permit. The Secretary was also given authority to inspect, seize and destroy products, and to quarantine areas, if necessary to prevent the spread of such weeds. He was also authorized to cooperate with other Federal, State and local agencies, farmers associations and private individuals in measures to control, eradicate, or prevent or retard the spread of such weeds.

Section 1453 of P.L. 101-624, the 1990 Farm Bill, enacted November 28, 1990 (104 Stat 3611) amended the Act by requiring each Federal land-managing agency to: Designate an office or person adequately trained in managing undesirable plant species to develop and coordinate a program to control such plants on the agency's land; Establish and adequately fund this plant management program through the agency's budget process; Complete and implement cooperative agreements (requirements for which are provided) with the States regarding undesirable plants on agency land; and Establish integrated management systems (as defined in the section) to control or contain undesirable plants targeted under the cooperative agreements.

The law also requires that any environmental assessments or impact statements that may be required to implement plant control agreements must be completed within 1 year of the time the need for the document is established.

P.L. 101-646 - Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990
Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA) --

This Act - **Title I of P.L. 101-646 (104 Stat. 4761, 16 U.S.C. 4701, enacted November 29, 1990)** established a broad new Federal program to prevent introduction of and to control the spread of introduced aquatic nuisance species and the brown tree snake. The U.S. Fish and Wildlife Service, the U.S. Coast Guard, the Environmental Protection Agency, the Army Corps of Engineers, and the National Oceanic and Atmospheric Administration all were assigned major, new responsibilities, including membership on an Aquatic Nuisance Species Task Force established to develop a program of prevention, monitoring, control, and study.

As a Task Force member and joint chair of the Task Force, the U.S. Fish and Wildlife Service must: (1) jointly conduct a study on the environmental effects of ballast water exchange on receiving water and identify areas within waters of the U.S. and the Exclusive Economic Zone where exchange of ballast water poses no threat; (2) jointly conduct a study of whether aquatic nuisance species threaten the ecological characteristics and uses of the waters of the U.S. other than the Great Lakes; and (3) cooperate in a study to determine the need for controls on vessels entering waters of the U.S. other than the Great Lakes.

The U.S. Fish and Wildlife Service must act with the National Oceanic and Atmospheric Administration as co-chair of the Aquatic Nuisance Species Task Force, and by May 29, 1991, the Director and the Under Secretary of NOAA were directed to develop an MOU describing their roles in carrying out the subtitle.

The Task Force, composed of Federal agencies and representatives of States and regional entities, is to develop and implement an aquatic nuisance species program to prevent their introduction and dispersal in waters of the U.S. The Director may make grants to States for implementation of approved management plans submitted by State Governors.

By November 29, 1991, the Task Force was directed to identify and evaluate approaches for reducing the risk of adverse consequences from intentional introductions and report to Congress.

The most recent amendments which affect the Department of the Interior and the Fish and Wildlife Service were passed on October 26, 1996. Among the provisions, **P.L. 104-332** orders the Secretary of the Interior and the Secretary of Commerce, with the concurrence of and in cooperation with the Secretary of Transportation, to conduct a ballast water management demonstration program to demonstrate technologies and practices to prevent the introduction of aquatic non-indigenous species into the Great Lakes and other United States waters. A report on the demonstration program is to be submitted to Congress no later than 3 years after the passage date of the amendments (110 Stat. 4083). Also, the Director of the Fish and Wildlife Service, the Secretary of Transportation and the Under Secretary of Commerce for Oceans and Atmosphere are

authorized to issue rules and regulations to implement the Aquatic Nuisance Species Program at the recommendation of the Aquatic Nuisance Species Task Force (110 Stat. 4085,4087,4091). The 1996 amendments also authorize the Director of the Fish and Wildlife Service to make grants to states with approved state or interstate invasive species management plans (110 Stat. 4089,4091). Finally, appropriations for the years 1997 to 2002 are made to the Secretary of the Department of the Interior and the Director of the Fish and Wildlife Service for prevention of unintentional introductions of aquatic nuisance species, for implementation of the Aquatic Nuisance Species Program (including the brown tree snake control program) and for making grants to states for implementation by the Director of the Fish and Wildlife Service in Rhode Island of their state management programs. Finally, appropriations are authorized for implementation of a Ballast Water Management Demonstration Program.

P.L. 104-332 - National Invasive Species Act of 1996

National Invasive Species Act (1996) -- This act amended NANPCA to mandate regulations to prevent introduction and spread of aquatic nuisance species into Great Lakes through ballast water. It authorized funding for research on aquatic nuisance species prevention and control (Chesapeake Bay, Gulf of Mexico, Pacific Coast, Atlantic Coast, San Francisco Bay- Delta Estuary). It required ballast water management program to demonstrate technologies and practices to prevent nonindigenous species from being introduced. It modified composition of Aquatic Nuisance Species Task Force and required Task Force to develop and implement comprehensive program to control the brown tree snake in Guam.

Title 18, Part 1, Chapter 3, Section 46- Transportation of Water Hyacinths

- (a) Whoever knowingly delivers or receives for transportation, or transports, in interstate commerce, alligator grass (*alternanthera philoxeroides*), or water chestnut plants (*trapa natans*) or water hyacinth plants (*eichhornia crassipes*) or the seeds of such grass or plants; or
- (b) Whoever knowingly sells, purchases, barter, exchanges, gives, or receives any grass, plant, or seed which has been transported in violation of subsection (a); or
- (c) Whoever knowingly delivers or receives for transportation, or transports, in interstate commerce, an advertisement, to sell, purchase, barter, exchange, give, or receive alligator grass or water chestnut plants or water hyacinth plants or the seeds of such grass or plants
- Shall be fined under this title, or imprisoned not more than six months, or both.

The Lacey Act (P.L. 97-79, 16 U.S.C. 3371-3378)

This law is triggered by interstate transport in conjunction with any violations of state law.

Lacey Act Amendments of 1981 (P.L. 97-79, 95 Stat. 1073, 16 U.S.C. 3371-3378, approved November 16, 1981, and as amended by P.L. 100-653, 102 Stat. 3825, approved November 14, 1988, and P.L. 98-327, 98 Stat. 271, approved June 25, 1984) These amendments repealed the Black Bass Act and sections 43 and 44 of the Lacey Act of 1900 (18 U.S.C. 43- 44), replacing them with a single comprehensive statute.

Under this law, it is unlawful to import, export, sell, acquire, or purchase fish, wildlife or plants taken, possessed, transported, or sold: 1) in violation of U.S. or Indian law, or 2) in interstate or foreign commerce involving any fish, wildlife, or plants taken possessed or sold in violation of State or foreign law.

The law covers all fish and wildlife and their parts or products, and plants protected by the Convention on International Trade in Endangered Species and those protected by State law. Commercial guiding and outfitting are considered to be a sale under the provisions of the Act.

Felony criminal sanctions are provided for violations involving imports or exports, or violations of a commercial nature in which the value of the wildlife is in excess of \$350. A misdemeanor violation was established, with a fine of up to \$10,000 and imprisonment of up to 1 year, or both. Civil penalties up to \$10,000 were provided. However, the Criminal Fines Improvement Act of 1987 increased the fines under the Lacey Act for misdemeanors to a maximum of \$100,000 for individuals and \$200,000 for organizations. Maximum fines for felonies were increased to \$250,000 for individuals and \$500,000 for organizations.

Rewards are authorized for information leading to arrests, criminal convictions, civil penalties, or the forfeitures of property, and for payment of costs of temporary care for fish, wildlife, or plants regarding a civil or criminal proceeding. Strict liability is established for forfeiture of illegal fish, wildlife or plants, and marking requirements for shipments of fish and wildlife must conform to modern commercial practices.

Those enforcing the Act are authorized to carry firearms, make qualified warrantless arrests for felony and misdemeanor violations of any law of the U.S. when enforcing the Act, search and seize under Attorney General guidelines, issue subpoenas and warrants, inspect vessels, vehicles, aircraft, packages, crates, and containers on arrival in the United States from outside the United States or prior to departure from the United States.

Amendments to the humane shipment provisions of Title 18 required the Secretary of the Interior to issue regulations governing such activity.

As amended May 24, 1949, 18 U.S.C. 42 (**63 Stat. 89, September 2, 1960; P.L. 86-702; 74 Stat. 753; and November 29, 1990, P.L. 101-646, 104 Stat. 4772**) prohibits importation of wild vertebrates and other animals listed in the Act or declared by the Secretary of the Interior to be injurious to man or agriculture, wildlife resources, or otherwise, except under certain circumstances and pursuant to regulations.

Anadromous Fish Conservation Act (16 USC 757a-757g; 79 Stat. 1125) as amended -
- Public Law 89-304, October 30, 1965, authorizes the Secretaries of the Interior and Commerce to enter into cooperative agreements with the States and other non-Federal interests for conservation, development, and enhancement of anadromous fish, including those in the Great Lakes, and to contribute up to 50 percent as the Federal share of the cost of carrying out such agreements.

Authorized are investigations, engineering and biological surveys, research, stream clearance, construction, maintenance and operations of hatcheries and devices and structures for improving movement, feeding and spawning conditions. Also authorized is construction by the Bureau of Reclamation and the Army Corps of Engineers of water resource projects needed solely for such fish.

Animal Damage Control Act (7 USC 426-426c) -- The Act of March 2, 1931, (**46 Stat. 1468**) provided broad authority for investigation, demonstrations and control of mammalian predators, rodents and birds.

Public Law 99-19, approved December 19, 1985, (**99 Stat 1185**) transferred administration of the Act from the Secretary of the Interior to the Secretary of Agriculture.

Pub. L. 102-190 (Div. A, title III, Sec. 348, Dec. 5, 1991, 105 Stat. 1348) and P.L. 102-237 (Title X, Sec. 1013(d), 105 Stat. 1901, Dec. 13, 1991) added provisions directing the Secretaries of Defense and Agriculture, respectively, to take actions to prevent the introduction of brown tree snakes into other areas of the U.S. from Guam.

P.L. 106-387, effective October 28, 2000, **114 Stat, 1549**, amended section 426 of the Act to give broad authority to the Secretary of Agriculture in carrying a wildlife services program with respect to injurious species.

Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended -- **Public Law 93-205**, approved December 28, 1973, repealed the Endangered Species Conservation Act of December 5, 1969 (**P.L. 91-135, 83 Stat. 275**). The 1969 Act had amended the Endangered Species Preservation Act of October 15, 1966 (**P.L. 89-669, 80 Stat. 926**). When non-native invasive species threaten endangered species, this act could be used as basis for their eradication.

The 1973 Act implemented the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES represents an alternate model for regulating invasive species not already covered by the IPPC or other agreements. CITES is intended to prevent harm in exporting country; however, it can be applied when species is endangered in exporting country and considered an invasive in importing country.

Through federal action and by encouraging the establishment of state programs, the 1973 Endangered Species Act provided for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife, and plants depend. The Act: authorizes the determination and listing of species as endangered and threatened; prohibits unauthorized taking, possession, sale, and transport of endangered species; provides authority to acquire land for the conservation of listed species, using land and water conservation funds; authorizes establishment of cooperative agreements and grants-in-aid to States that establish and maintain active and adequate programs for endangered and threatened wildlife and plants; authorizes the assessment of civil and criminal

penalties for violating the Act or regulations; and authorizes the payment of rewards to anyone furnishing information leading to arrest and conviction for any violation of the Act.

Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777k, 64 Stat. 430), as amended -- This August 9, 1950, Act has been amended several times and is commonly called the Dingell-Johnson Act or Wallop-Breaux Act. It provides Federal aid to the States for management and restoration of fish having "material value in connection with sport or recreation in the marine and/or fresh waters of the United States." In addition, amendments to the Act provide funds to the states for aquatic education, wetlands restoration, boat safety and clean vessel sanitation devices (pump outs), and a nontrailerable boat program.

Funds distributed to states for the various programs funded in the Act are collected in an account known as the Sport Fish Restoration Account, one of two accounts in the Aquatic Resources Trust Fund established under the authority of the internal revenue code (**26 U.S.C. 9504(a)**). Unless otherwise specified in the Act, funds are permanently appropriated (see **P.L. 136, August 31, 1951; 65 Stat. 262**). Funds are derived from a 10-percent excise tax on certain items of sport fishing tackle (**Internal Revenue Code of 1954, sec. 4161**), a 3-percent excise tax on fish finders and electric trolling motors, import duties on fishing tackle, yachts and pleasure craft, interest on the account, and a portion of motorboat fuel tax revenues and small engine fuel taxes authorized under the Internal Revenue Code (**Sec. 9503**).

To be eligible to participate in the Federal Aid in Sport Fish Restoration program, states are required to assent to this law and pass laws for the conservation of fish which include a prohibition against the diversion of license fees for any other purpose than the administration of the state fish department.

Funds for the permanently appropriated States sport fish program are apportioned on a formula basis for paying up to 75 percent of the cost of approved projects which include acquisition and improvement of sport fish habitat, stocking of fish, research into fishery resource problems, surveys and inventories of sport fish populations, and acquisition and development of access facilities for public use. Funds for the remaining programs under the Act must be authorized to be appropriated from the Sport Fish Restoration Account by Congress.

Fish and Wildlife Conservation Act ("Nongame Act"; 16 U.S.C. 2901-2911; 94 Stat. 1322) -- **Public Law 96-366**, approved September 29, 1980, authorizes financial and technical assistance to the States for the development, revision, and implementation of conservation plans and programs for nongame fish and wildlife. The original Act authorized \$5 million for each of Fiscal Years 1982 through 1985, for grants for development and implementation of comprehensive State nongame fish and wildlife plans and for administration of the Act. It also required the U.S. Fish and Wildlife Service to study potential mechanisms for funding these activities and report to Congress by March 1984.

Fish and Wildlife Act of 1956 (16 U.S.C. 742a-742j, not including 742 d-l; 70 Stat. 1119), as amended -- The Act of August 8, 1956, as frequently amended, establishes a comprehensive national fish, shellfish, and wildlife resources policy with emphasis on the commercial fishing industry but also with a direction to administer the Act with regard to the inherent right of every citizen and resident to fish for pleasure, enjoyment, and betterment and to maintain and increase public opportunities for recreational use of fish and wildlife resources.

Among other things, it directs a program of continuing research, extension, and information services on fish and wildlife matters, both domestically and internationally. Section 7(a) of the Act (**16 U.S.C. 742f; 70 Stat. 1122**) requires the Secretary of the Interior to: 1) develop measures for "maximum sustainable production of fish"; 2) make economic studies of the industry and recommend measures to insure stability of the domestic fisheries; 3) undertake promotional and information activities to stimulate consumption of fishery products; 4) take steps "required for the development, advancement, management, conservation, and protection of the fisheries resources," and take steps "required for the development, management, advancement, conservation, and protection of fish and wildlife resources" through research, acquisition of land and water or interests therein, development of existing facilities, and other means.

A Reorganization Plan of October 3, 1970 (**84 Stat. 2090**), abolished the Bureau of Commercial Fisheries and transferred functions related to commercial fisheries and marine sport fisheries, except Great Lakes fishery research and certain other fishery related activities, to the Department of Commerce, National Oceanic and Atmospheric Administration.

Fish and Wildlife Coordination Act (16 U.S.C. 661-667e; the Act of March 10, 1934; Ch. 55; 48 Stat. 401), as amended -- The Act of March 10, 1934, authorizes the Secretaries of Agriculture and Commerce to provide assistance to and cooperate with Federal and State agencies to protect, rear, stock, and increase the supply of game and fur-bearing animals, as well as to study the effects of domestic sewage, trade wastes, and other polluting substances on wildlife.

The Act also directs the Bureau of Fisheries to use impounded waters for fish-culture stations and migratory-bird resting and nesting areas and requires consultation with the Bureau of Fisheries prior to the construction of any new dams to provide for fish migration. In addition, this Act authorizes the preparation of plans to protect wildlife resources, the completion of wildlife surveys on public lands, and the acceptance by the Federal agencies of funds or lands for related purposes provided that land donations received the consent of the State in which they are located.

The amendments enacted in 1946 require consultation with the Fish and Wildlife Service and the fish and wildlife agencies of States where the "waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted . . . or otherwise controlled or modified" by any agency under a Federal permit or license.

Consultation is to be undertaken for the purpose of "preventing loss of and damage to wildlife resources."

The 1958 amendments titled the law as the Fish and Wildlife Coordination Act and added provisions to recognize the vital contribution of wildlife resources to the Nation and to require equal consideration and coordination of wildlife conservation with other water resources development programs, and authorized the Secretary of Interior to provide public fishing areas and accept donations of lands and funds.

Fishery Conservation and Management Act of 1976 -- Public Law 94-265, approved April 13, 1976; **16 U.S.C. 1801-1882; 90 Stat. 331**; as amended by numerous subsequent public laws listed and identified in the U.S. Code.

Also known as Magnuson Fishery Conservation and Management Act, this law established a 200-mile fishery conservation zone, effective March 1, 1977, and established Regional Fishery Management Councils comprised of Federal and State officials, including the Fish and Wildlife Service. The concept of a fishery conservation zone was subsequently dropped by amendment and the geographical area of coverage was changed to the Exclusive Economic Zone (EEZ), with the inner boundary being the seaward boundary of the coastal States.

The Act provides for management of fish and other species in the EEZ under plans drawn up by the Regional Councils and reviewed and approved by the Secretary of Commerce. It provides for regulation of foreign fishing in the management zone under GIFA's (governing international fishing agreements) and vessel fishing permits. It also provides a mechanism for preemption of State law by the Secretary of Commerce.

National Environmental Policy Act of 1969, as amended -- Title I of the 1969 National Environmental Policy Act (NEPA) requires that all Federal agencies prepare detailed environmental impact statements for "every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment.

The 1969 statute stipulated the factors to be considered in environmental impact statements, and required that Federal agencies employ an interdisciplinary approach in related decision-making and develop means to ensure that unquantified environmental values are given appropriate consideration, along with economic and technical considerations.

Title II of this statute requires annual reports on environmental quality from the President to the Congress, and established a Council on Environmental Quality in the Executive Office of the President with specific duties and functions.

Amendments enacted in 1975 authorized additional appropriations for the Council on Environmental Quality (**P.L. 94-52**) and contained various administrative provisions.

Public Law 94-83 clarified the application of NEPA to the preparation of impact statements for projects implemented by States under a system of Federal grants.

Executive Order 13112 of February 3, 1999 12.1

On Feb 3, 1999, **Executive Order 13112** was signed establishing the National Invasive Species Council. The Executive Order requires that a Council of Departments dealing with invasive species be created. Currently there are 13 Departments and Agencies on the **Council**. It defines invasive species (an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health). Directs all federal agencies to address invasive species concerns, refrain from actions likely to increase invasive species problems, creates interagency Invasive Species Council and calls for National Invasive Species Management Plan to better coordinate federal agency efforts. **Executive Order 13112 of February 3, 1999 - Invasive Species (PDF | 67 KB)**
Federal Register: Feb 8, 1999 (Volume 64, Number 25)

By the authority vested in me as President by the Constitution and the laws of the United States of America, including the National Environmental Policy Act of 1969, as amended (**42 U.S.C. 4321 *et seq.***), Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, as amended (**16 U.S.C. 4701 *et seq.***), Lacey Act, as amended (**18 U.S.C. 42**), Federal Plant Pest Act (**7 U.S.C. 150aa *et seq.***), Federal Noxious Weed Act of 1974, as amended (**7 U.S.C. 2801 *et seq.***), Endangered Species Act of 1973, as amended (**16 U.S.C. 1531 *et seq.***), and other pertinent statutes, to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause, it is ordered as follows:

- **Section 1. Definitions**
- **Section 2. Federal Agency Duties**
- **Section 3. Invasive Species Council**
- **Section 4. Duties of the Invasive Species Council**
- **Section 5. Invasive Species Management Plan**
- **Section 6. Judicial Review and Administration**

Section 1. Definitions.

(a) "Alien species" means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem.

(b) "Control" means, as appropriate, eradicating, suppressing, reducing, or managing invasive species populations, preventing spread of invasive species from areas where they are present, and taking steps such as restoration of native species and habitats to reduce the effects of invasive species and to prevent further invasions.

(c) "Ecosystem" means the complex of a community of organisms and its environment.

(d) "Federal agency" means an executive department or agency, but does not include independent establishments as defined by 5 U.S.C. 104.

(e) "Introduction" means the intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity.

(f) "Invasive species" means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

(g) "Native species" means, with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.

(h) "Species" means a group of organisms all of which have a high degree of physical and genetic similarity, generally interbreed only among themselves, and show persistent differences from members of allied groups of organisms.

(i) "Stakeholders" means, but is not limited to, State, tribal, and local government agencies, academic institutions, the scientific community, nongovernmental entities including environmental, agricultural, and conservation organizations, trade groups, commercial interests, and private landowners.

(j) "United States" means the 50 States, the District of Columbia, Puerto Rico, Guam, and all possessions, territories, and the territorial sea of the United States.

Section 2. Federal Agency Duties.

(a) Each Federal agency whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law,

(1) identify such actions;

(2) subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them; and

(3) not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions.

(b) Federal agencies shall pursue the duties set forth in this section in consultation with the Invasive Species Council, consistent with the Invasive Species Management Plan and in cooperation with stakeholders, as appropriate, and, as approved by the Department of State, when Federal agencies are working with international organizations and foreign nations.

Section 3. Invasive Species Council.

(a) An Invasive Species Council (Council) is hereby established whose members shall include the Secretary of State, the Secretary of the Treasury, the Secretary of Defense, the Secretary of the Interior, the Secretary of Agriculture, the Secretary of Commerce, the Secretary of Transportation, and the Administrator of the Environmental Protection Agency. The Council shall be Co-Chaired by the

Secretary of the Interior, the Secretary of Agriculture, and the Secretary of Commerce. The Council may invite additional Federal agency representatives to be members, including representatives from subcabinet bureaus or offices with significant responsibilities concerning invasive species, and may prescribe special procedures for their participation. The Secretary of the Interior shall, with concurrence of the Co-Chairs, appoint an Executive Director of the Council and shall provide the staff and administrative support for the Council. (b) The Secretary of the Interior shall establish an advisory committee under the Federal Advisory Committee Act, 5 U.S.C. App., to provide information and advice for consideration by the Council, and shall, after consultation with other members of the Council, appoint members of the advisory committee representing stakeholders. Among other things, the advisory committee shall recommend plans and actions at local, tribal, State, regional, and ecosystem-based levels to achieve the goals and objectives of the Management Plan in section 5 of this order. The advisory committee shall act in cooperation with stakeholders and existing organizations addressing invasive species. The Department of the Interior shall provide the administrative and financial support for the advisory committee.

Section 4. Duties of the Invasive Species Council.

The Invasive Species Council shall provide national leadership regarding invasive species, and shall:

- (a) oversee the implementation of this order and see that the Federal agency activities concerning invasive species are coordinated, complementary, cost-efficient, and effective, relying to the extent feasible and appropriate on existing organizations addressing invasive species, such as the Aquatic Nuisance Species Task Force, the Federal Interagency Committee for the Management of Noxious and Exotic Weeds, and the Committee on Environment and Natural Resources;
- (b) encourage planning and action at local, tribal, State, regional, and ecosystem-based levels to achieve the goals and objectives of the Management Plan in section 5 of this order, in cooperation with stakeholders and existing organizations addressing invasive species;
- (c) develop recommendations for international cooperation in addressing invasive species;
- (d) develop, in consultation with the Council on Environmental Quality, guidance to Federal agencies pursuant to the National Environmental Policy Act on prevention and control of invasive species, including the procurement, use, and maintenance of native species as they affect invasive species;
- (e) facilitate development of a coordinated network among Federal agencies to document, evaluate, and monitor impacts from invasive species on the economy, the environment, and human health;
- (f) facilitate establishment of a coordinated, up-to-date information-sharing system that utilizes, to the greatest extent practicable, the Internet; this system shall facilitate access to and exchange of information concerning invasive species, including, but not limited to, information on distribution and abundance of invasive species; life histories of such species and invasive characteristics; economic, environmental, and human health

impacts; management techniques, and laws and programs for management, research, and public education; and

(g) prepare and issue a national Invasive Species Management Plan as set forth in section 5 of this order.

Section 5. Invasive Species Management Plan.

(a) Within 18 months after issuance of this order, the Council shall prepare and issue the first edition of a National Invasive Species Management Plan (Management Plan), which shall detail and recommend performance-oriented goals and objectives and specific measures of success for Federal agency efforts concerning invasive species. The Management Plan shall recommend specific objectives and measures for carrying out each of the Federal agency duties established in section 2(a) of this order and shall set forth steps to be taken by the Council to carry out the duties assigned to it under section 4 of this order. The Management Plan shall be developed through a public process and in consultation with Federal agencies and stakeholders.

(b) The first edition of the Management Plan shall include a review of existing and prospective approaches and authorities for preventing the introduction and spread of invasive species, including those for identifying pathways by which invasive species are introduced and for minimizing the risk of introductions via those pathways, and shall identify research needs and recommend measures to minimize the risk that introductions will occur. Such recommended measures shall provide for a science-based process to evaluate risks associated with introduction and spread of invasive species and a coordinated and systematic risk-based process to identify, monitor, and interdict pathways that may be involved in the introduction of invasive species. If recommended measures are not authorized by current law, the Council shall develop and recommend to the President through its Co-Chairs legislative proposals for necessary changes in authority.

(c) The Council shall update the Management Plan biennially and shall concurrently evaluate and report on success in achieving the goals and objectives set forth in the Management Plan. The Management Plan shall identify the personnel, other resources, and additional levels of coordination needed to achieve the Management Plan's identified goals and objectives, and the Council shall provide each edition of the Management Plan and each report on it to the Office of Management and Budget. Within 18 months after measures have been recommended by the Council in any edition of the Management Plan, each Federal agency whose action is required to implement such measures shall either take the action recommended or shall provide the Council with an explanation of why the action is not feasible. The Council shall assess the effectiveness of this order no less than once each 5 years after the order is issued and shall report to the Office of Management and Budget on whether the order should be revised.

Section 6. Judicial Review and Administration.

(a) This order is intended only to improve the internal management of the executive branch and is not intended to create any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity by a party against the United States, its agencies, its officers, or any other person.

(b) Executive Order 11987 of May 24, 1977, is hereby revoked.

(c) The requirements of this order do not affect the obligations of Federal agencies under 16 U.S.C. 4713 with respect to ballast water programs.

(d) The requirements of section 2(a)(3) of this order shall not apply to any action of the Department of State or Department of Defense if the Secretary of State or the Secretary of Defense finds that exemption from such requirements is necessary for foreign policy or national security reasons.

WILLIAM J. CLINTON
THE WHITE HOUSE,
February 3, 1999.

U.S. FISH AND WILDLIFE SERVICE POLICIES

710 FW 4 (Fish Stocking Policy) - *currently under review*

712 FW 1 (Fish Broodstock Policy) - *currently under review*

712 FW 3 (Fish Production and Distribution) - *currently under review*

713 FW 1 (Aquatic Animal Health Policy Overview) - This chapter establishes the Fish and Wildlife Service Aquatic Animal Health Policy and standards. This, along with the U.S. Fish and Wildlife Service Handbook of Aquatic Animal Health Procedures and Protocols serve as the basis for the Service's efforts to contain, control, and minimize the impacts of aquatic animal pathogens and diseases on Service-managed and Service-contracted properties (i.e., lands, waters, facilities, and Service-contracted hatcheries).

713 FW 5 (Special Case Aquatic Animal Movements and Controlled Propagation Programs) - This chapter provides guidelines for the generation of fish health recommendations to Fish and Wildlife Service facilities and personnel involved in the movement and rearing of special case aquatic animals. This chapter attempts to balance the resource need for imperiled aquatic animal propagation and our declared position on fish health activities.

715 FW 1 (Aquaculture; Policies and Responsibilities) - This chapter promulgates policies, roles, and responsibilities applicable to the U.S. Fish and Wildlife Service's aquaculture program.

716 FW 1 (Interjurisdictional Fisheries; Policy and Responsibilities) - *currently under review*

716 FW 2 (Interjurisdictional Fisheries; Management Plan Development) - *currently under review*

716 FW 3 (Interjurisdictional Fisheries; Stock Assessment) - *currently under review*

716 FW 4 (Interjurisdictional Fisheries; Restoration Coordination) - *currently under review*

CODE OF FEDERAL REGULATIONS

50 CFR 16.13 -- Current list of injurious live or dead fish, mollusks, crustaceans, or their eggs

50 CFR 16.15 -- Current list of injurious live reptiles or their eggs

OTHER AGREEMENTS

Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) (1995) -- A supplementary agreement to the World Trade Organization Agreement. Provides a uniform interpretation of the measures governing safety and plant and animal health regulations. Applicable to all sanitary and Phytosanitary measures directly or indirectly affecting international trade. Sanitary and Phytosanitary measures are defined as any measure applied a) to protect animal or plant life or health within (a Members' Territory) from entry, establishment or spread of pests, diseases, disease carrying organisms; e) to prevent or limit other damage within the (Members Territory) from the entry, establishment or spread of pests (annex A).

APPENDIX G. SUMMARY OF INTERNATIONAL LAWS AND TREATIES RELEVANT TO AQUATIC INVASIVE SPECIES

International Laws

Codex Alimentarius Commission

The United Nations' Food and Agricultural Organization (FAO) and the World Health Organization

(WHO) created the Codex Alimentarius Commission (Codex) in 1962.¹ The purpose of the Codex is to encourage fair international trade in food while promoting the health and economic interests of consumers.² In the United States, Codex activities are coordinated by the USDA, EPA, and Food and Drug Administration.³ Volume 1A of the Codex empowers the Commission to create specialized committees. One such committee that relates to invasive species is the Committee on Import/Export Inspection and Certification Systems.⁴ To fulfill its goal of protecting consumer health in the area of food safety. The Codex has formulated standards for specific food commodities, pesticide and drug residues, food contaminants and additives, labeling, and food safety.⁵ Invasive species are relevant to the Codex if they threaten food safety or the international food trade.

Convention on Biological Diversity

The Convention on Biological Diversity (CBD) recognizes the importance of "ecological, genetic, social, economic, scientific, educational, cultural, recreational, and aesthetic" values of biological diversity throughout the world.⁶ Countries have rights over their own biological resources, but also have the responsibility of conserving them and using them in a sustainable manner.⁷ A fundamental requirement for the conservation of biological diversity is In-Situ conservation. ⁸ The CBD recognizes the need to "prevent the introduction of and control or eradicate those alien species which threaten ecosystems, habitats, or species."⁹ The CBD has a program to target introduction of invasive species.¹⁰ The Global Invasive Species Programme works with the CBD to provide expertise through the CBD's Subsidiary Body on Science, Technology, and Technical Assistance.¹¹ The United States has not ratified the agreement.

Convention on International Trade in Endangered Species of Wild Flora and Fauna

The purpose of The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) is to foster international cooperation in order to protect certain species of flora and fauna from over-exploitation through international trade.¹² CITES divides species of wild flora and fauna into three appendices. Trade of any species in Appendices I, II, or III is prohibited, except in accordance with provisions set forth in CITES.¹³ Trade of species included in Appendices I, II, and III are regulated through a system of import, export, and re-export permits.¹⁴

¹ See Food Safety and Inspection Service U.S. Codex Office, Codex Alimentarius Commission. Retrieved 17 February 2003 from www.fsis.usda.gov/OA/codex/.

² See *id.*

³ See *id.*

4 See FAO/WHO Food Standards, Codex Alimentarius. Retrieved 17 February 2003 from www.codexalimentarius.net/.

5 See *id.*

6 Convention on Biological Diversity, June 5, 1992, Preamble.

7 See *id.*

8 In-Situ conservation means "the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties." *Id.* Article 2.

9 *Id.* Article 2(h).

10 See Convention on Biological Diversity, Alien Species Introduction. Retrieved 17 February 2003 from www.biodiv.org/programmes/cross-cutting/alien/.

11 See Convention on Biological Diversity, Alien Species Introduction. Retrieved 17 February 2003 from www.biodiv.org/programmes/cross-cutting/alien/gisp.asp.

12 See Convention on International Trade of Endangered Species of Wild Flora and Fauna, March 3, 1973, Preamble.

13 See *id.* Article II.4.

14 See *id.* Article III.2, III.3, and III.4. See also Article IV.2, IV.3, IV.4, and IV.5 and Article V.2, V.3, and V.4.

Appendix I includes species threatened with extinction that are or may be affected by trade.

Trading members of these species are the most strictly regulated in order not to further endanger their survival.¹⁵ For these species, trade is authorized in only "exceptional" circumstances.¹⁶ Appendix II includes species that currently are not threatened with extinction, but would become so threatened without strict regulation.¹⁷ Appendix II also recognizes that trade in other species also must be regulated in order to effectively protect species included in Appendix II.¹⁸

Appendix III includes all species that any Party to CITES declares to be subject to regulation within its jurisdiction to prevent or restrict exploitation, and "as needing cooperation of other parties in the control of trade."¹⁹

Office of International Epizootics

The Office of International Epizootics (OIE) is an international organization created by agreement in 1924. Its purposes are to guarantee the transparency of animal diseases worldwide; to collect, analyze, and disseminate veterinary scientific information; to provide expertise and promote international solidarity for the control of animal diseases; and to guarantee the sanitary safety of world trade by developing sanitary rules for international trade in animals and animal products.²⁰ The OIE collects and disseminates information through cooperation between Member Countries. Each Member reports to the OIE animal diseases that it identifies within its territory.²¹ The OIE thereby disseminates this information to other Members so that each may act upon this information accordingly.²² The OIE provides technical support to Member Countries that request assistance in controlling and eradicating animal diseases.²³ The OIE also

creates “normative documents relating to rules that Member Countries can use to protect themselves from diseases without setting unjustified sanitary barriers.”²⁴ Such normative documents include the International Animal Health Code²⁵ and Manual Standards for Diagnostic Tests and Vaccines.²⁶ While the OIE generally focuses on issues such as livestock diseases and developing standards for diagnostic tests and vaccines, it recently has started to focus on diseases affecting wildlife, including aquatic species, by publishing its International Aquatic Animal Health Code.²⁷

International Plant Protection Convention

The purpose of the International Plant Protection Convention (IPPC) is to prevent the introduction and spread of pests of plants and plant products and to promote appropriate control measures.²⁸ The IPPC was adopted in 1951 and was revised in November 1997. However, the 1997 revision, while adopted, is not yet in force.²⁹ Under the IPPC, each contracting party agrees to cooperate with each other to prevent the introduction of plant pests and diseases and prevent their spread across national boundaries.³⁰ The Food and Agriculture Organization of the United Nations

15 *See id.* Article II.1.

16 *Id.*

17 *See id.* Article II.2(a).

18 *See id.* Article II.2(b).

19 *See id.* Article II.3.

20 *See* Office of International Epizootics, What is the OIE?. Retrieved 17 February 2003 from www.oie.int/eng/OIE/en_oie.htm.

21 *See id.*

22 *See id.*

23 *See id.*

24 *See id.*

25 *See* Office of International Epizootics, Terrestrial Animal Health Code 2003.

Retrieved 25 July 2003 from www.oie.int/eng/normes/mcode/A_summry.htm.

26 *See* Office of International Epizootics, Manual Standards for Diagnostic Tests and Vaccines 2000. Retrieved 28 February 2003 from www.oie.int/eng/normes/mmanual/A_summry.htm.

27 *See* Office of International Epizootics, International Aquatic Animal Health Code 2002. Retrieved 28 February 2003 from www.oie.int/eng/normes/fcode/A_summry.htm.

28 *See* International Plant Protection Convention, December 6, 1951, current text adopted in 1979, Article I.1.

29 *See* International Phytosanitary Portal, Documents and Publications. Retrieved 3 March 2003 from www.ippc.int/cds_ippc_prod/IPPC/En/publications.htm.

30 *See* International Plant Protection Convention, December 5, 1951, current text adopted in 1979, Preamble. disseminates information on import restrictions, requirements, prohibitions, and regulations to all contracting parties and regional plant protection organizations.

31 Each contracting party is responsible for creating a national plant organization to carry out the provisions of the IPPC, such as inspection of consignments of plants and plant products moving in international traffic that may carry pests and diseases and protecting endangered areas.

32 If necessary for phytosanitary conditions, contracting parties may regulate the entry of plants into their territories by setting requirements of importation; prohibiting importation of specific plants; inspecting and detaining specific plants; and treating, destroying, or refusing entry to specific plants.

33 However, contracting parties shall not take measure more stringent than necessary to accomplish the goals of the IPPC in order to minimize interference with international trade.

34

North American Free Trade Agreement

The main objectives of the North American Free Trade Agreement (NAFTA) are to eliminate trade barriers and to promote fair competition between the Parties to the Agreement.³⁵ NAFTA requires that each Party to the greatest extent practicable, participate in international and North American standardizing organizations, such as the Codex, OIE, IPPC, and North American Plant Protection Organization, to promote the "development and periodic review of international standards, guidelines and recommendations."

36 Chapter 7 relates to invasive species. It allows each Party to adopt sanitary or phytosanitary measures necessary for the protection of human, animal, or plant life or health in its territory.³⁷ Such measures may be more stringent than international standards, guidelines, or recommendations.³⁸ Such measures should be based on research and risk assessment.³⁹ However, measures should not arbitrarily or unjustifiably discriminate against another Party's goods.⁴⁰ Furthermore, in conducting risk assessments in order to determine appropriate measures of protection, one of the factors that the Parties must take into account is "the prevalence of relevant diseases or pests, including the existence of pest-free or disease-free areas or areas of low pest or disease prevalence."⁴¹

World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures

The Sanitary and Phytosanitary Measures Agreement (SPS Agreement) is a supplement to the World Trade Organization Agreement. It encourages Members to adopt measures necessary to protect human, animal or plant life or health.⁴² However, such measures should not arbitrarily or unjustifiably discriminate against Members that experience the same conditions in their territories or be disguised as a restriction on international trade.⁴³ The SPS Agreement also encourages Members to use other international guidelines, such as the Codex, OIE, and IPPC⁴⁴ to promote within these organizations the development and periodic review of standards, guidelines, and recommendations with respect to all aspects of sanitary and phytosanitary measures.⁴⁵ The SPS Agreement Members should conduct scientific research and collect evidence in order to set appropriate levels of sanitary and phytosanitary protection with the least impact on international

31 *See id.* Article VI.4.

32 *See id.* Article IV.1(a)(i), (ii).

33 *See id.* Article VI.1.

34 *See id.* Article VI.2.

- 35 *See* North American Free Trade Agreement, 17 December 1992, Article 102.
36 *Id.* Chapter 7, § B, Art. 713(5).
37 *See id.* Chapter 7, § B, Art. 712(1).
38 *See id.*
39 *See id.* Chapter 7, § B, Art. 715(1).
40 *See id.* Chapter 7, § B, Art. 712(4))
41 *Id.* Chapter 7, § B, Art.715(1)(e).
42 *See* Agreement on Sanitary and Phytosanitary Measures, 15 April 1994, Preamble.
43 *See id.* Article 5.5.
44 *See id.* Preamble. *See also* Article 3.4.
45 *See id.* Article 3.4.

trade.⁴⁶ Such evidence includes the prevalence of specific diseases or pests, existence of pest-free or disease-free areas, relevant ecological and environmental conditions, and quarantine or other treatment.⁴⁷

APPENDIX H. PUBLIC COMMENTS RECEIVED AND RESPONSES

